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Hygiene.

BY ALFRED CARPENTER, M.D., M.R.C.P. (LOND.).

HOW TO PREVENT DISEASE IN SCHOOL AND HOME (*continued.*)

Hydrophobia and Rabies (*continued*).—The virus is usually slow in developing its action. The wound generally heals rapidly. The seed sown shows its first manifestation in what is called the *melancholic* stage. There may be depression of spirits. The patient may be absent-minded or talkative; there is uneasiness and undefinable anxiety. There is dislike to fluids before the next state, that of *excitement*, comes on, and then the marked symptoms of the disease show themselves; great thirst, dry mouth, tenacious saliva, the patient making noises as he tries to spit out the gummy matter, sometimes mistaken for the bark of a dog. The horror at the sight or sound of liquid is intense, the disease when thus established is usually fatal. Local applications at the first moment, such as nitric acid, sulphurous acid, and full doses of bromides given until the characteristic symptoms produced by that drug have set in, seems to me to be the best means for arresting its progress. But whilst disease kills one person, fear kills ten. It is the fear of mischief from the bite of a dog rather than the effect of the bite itself, which produces most evil at this present time, causing cases to develope which, without the fear, would never have been heard of. The hysterical way in which patients are hurried off to Pasteur's laboratory in Paris is not indicative of ability to treat the malady on a good basis. Pasteur proposes to destroy the malignancy of the infection by a modified disease produced by inoculation with an attenuated virus. I have met with about 400 bites from dogs in the course of my life, some of which were supposed to be rabid, but not one of these cases has developed as Hydrophobia, though I used only ordinary means for cure. I have no true evidence that the cases I treated were bites from rabid animals. But so in Pasteur's cases there is only presumptive proof of rabies in the majority of them, for not one dog in a hundred which has been ruthlessly and cruelly killed on suspicion of rabies, was actually suffering from it. It is right to treat every bite with a caustic application as quickly as possible, to wash away the blood, if any, and pour in sulphurous acid that can be easily procured, if not otherwise at hand, by burning sulphur, and holding the injured part in the fumes of the gas, and washing it with water in which the fumes have been dissolved. I prefer this plan to the actual cautory, which may not reach the bottom of the wound, and does injuriously affect the nervous system of the patient. Continue the application of the sulphurous acid until it causes some actual pain, and then cover over with carbolised oil, and keep the part perfectly quiet until the wound is healed; cause the patient, if possible, to forget it altogether. As regards prevention among dogs themselves, I should prefer an order that all dogs wear a collar with the name of its owner, and a stamp indicative of having paid the dog tax upon it. That owner should then be held responsible at law for all the consequences which may ensue from the dog's ferociousness. Strings and muzzles are provocatives to irritability, not preventives of rabies. The judgment of a policeman in such matters is almost certain to err on the side of cruelty and against the dog. It is human to return a blow or a kick; dogs have less of the Christian's faith in non-resistance than man has, and are almost certain to retaliate under similar circumstances. To come to the conclusion that a dog is mad because it attempted to bite a policeman or anybody else is very unsatisfactory logic, and yet the supposed increase of rabies rests upon no more substantial basis than this. To treat dogs as if they were necessarily liable to madness is as sensible as to keep men in straight waistcoats because it is possible that one in a hundred thousand might develope a homicidal tendency.

Quarantine is a term which is applied to the restricted movements of persons who arrive in one country from another in which an infectious disease is prevalent. It was assumed that all infectious matter required not more than 40 days for its development as an active disease; hence the name. If the person

was quite well at the end of that time there would be no further risk in personal intercourse with him. He was confined therefore in some safe place until that time had expired.

Quarantine may be considered under two heads: 1. That which has reference solely to seaports in which the port sanitary authority has considerable power to detain and treat ships and persons arriving from infected places. The only point with which we have to deal in this paper connected with this head is the regulation that every person so arriving in this country, and passing from a seaport into the interior, should, even if perfectly satisfactory in other ways, yet give notice to the district to which he passes that he comes from a dangerous place. The institution of Quarantine was often a terror, and attended by acts of cruelty. Isolation was the only source of protection in the Middle Ages. It was unsuccessful. There are persons still in the world who consider complete non-intercourse as the proper way to deal with diseases such as cholera, yellow fever, and small pox. There are also advocates for unrestricted intercourse who believe in the control of such disease by hygienic and other measures, such as vaccination, for protection against the spread of infection. The first class fail when they place barriers between healthy and unhealthy districts, because they cannot control human nature. The second class fail because they cannot ensure the perfect hygienic works which they indicate as necessary to be carried out. Port quarantine need not be further considered, but children coming to English schools from India, Egypt, or other dependency in which cholera may be active, may in these days of rapid travelling bring the germs of disease with them, and the arrival of such should be notified to the medical officer of health of the district.

Inland Quarantine may be considered under two heads: (1) That which the local authority may require to be observed; and (2) That which may be instituted by the head of the family for the protection of the rest of the household from attack when one of the inmates, or a near neighbour, becomes the victim of some such disease as small pox, typhus fever, scarlatina, or cholera, &c. The local authorities' action will consist in the prohibition of intercourse between the sick and those directly attending upon them, with the rest of the people. There should also be a demand made that every case developing should be immediately notified to the local authority at the office of the medical officer of health, so that the authority may take immediate measures for the disinfection of the sewers or drains into which the excreta of the sick may have to pass. It would also enable them to make a very close inspection of the district in which the case is located, as to its present hygienic state. These are duties which at once devolve upon the local authorities, and are the real principles upon which a useful quarantine depends for success, using the term in its active not its original meaning. In countries in which cholera and yellow fever are epidemic or frequently epidemic, Quarantine includes much more than I have above indicated, but whilst self-defence may be thought the first law of nature, and as it is sometimes expressed '*Salus populi suprema lex*,' much mischief has been done upon mistaken ideas. Those mistakes are not so likely to arise in the future, an inculcation of a knowledge of proper sanitary law has done very much to get rid of the cruelty formerly practised, and the laws regulating personal freedom prevent hardship unless there is danger to other people of a very manifest character. Personal quarantine has been dealt with very much under the head of the particular disease from which the patient is suffering, and need not be again recapitulated, except to observe that it is not so much the mere time that has elapsed since the disease departed, as the absolute disinfection and destruction of the sequelæ of the disease. In the case of small pox it is the scabs from the eruption, in that of scarlatina it is the scales from the skin, and the desquamation or skinning which takes place in the glands of the kidneys. In that of cholera it is the actual excreta alone with the *debris* from the skin, and a patient is not dangerous as soon as the disease has departed, if proper personal cleanliness be observed. The cleansing of a patient from the effects of small pox and scarlatina is a much less troublesome process than is frequently thought, by even medical men, if it is set about on scientific principles, these involve cutting and cleansing the hair, paring the nails, washing out the orifices of the body, such as the ears, the navel, and other similar crevices, and scrubbing beneath the nails, washing the groins, armpits, &c., using solution of carbolic soap, after sponging over with a solution of permanganate of iron (Condy's fluid one part in 20). If these rules are carefully observed, and if the patient after the last bath be clothed with perfectly clean clothes, which have not been in any way exposed to infection he may mix with his fellows in much shorter time than is usually allowed, provided he has no open sores. The active sequelæ of the disease, if such are present, must be treated before the isolation is departed from. In many places there are bye laws carried out by the local authority, regulating the conduct of individuals under such circumstances. The general law of the land imposes penalties in all places upon those who expose themselves or cause others to be exposed whilst suffering from some infectious disease, and it is absolutely necessary that school teachers should require such laws to be strictly observed. In no case should the master hesitate to advise the managers upon the fact of any action contrary to the spirit or even letter of the general or bye-law. The managers should for their own protection, but not for vindictive purposes, always summon the offender before a court of summary jurisdiction, so that the neighbourhood may have their attention forcibly called to the duty which one person owes to another, under such circumstances, even among the poorest of the poor.

The Notification of Infectious Disease.—Many towns have Acts of Parliament called Local Acts, which among other things give the local authority power to demand that the presence of certain infectious diseases should be notified to them as soon as possible after its discovery. Many towns have clauses which require that the notification be made both by the medical attendant, and also by the householder or other person having charge of the patient. This is a quite unnecessary stretch of authority, and is doing harm, not good, to the cause of sanitary science. Nearly the whole of the progress which has been made in prevention of infectious disease is due to medical assistance. To place the profession in the invidious position of being common informers is neither just nor generous. It is also altogether unnecessary; if it be known that a case has arisen, it is always competent

for the local authority to put the medical attendant in the witness box, and thus convict the delinquent. This is now impossible in those places in which dual notification exists, for the medical attendant is made a '*particeps criminis*,' and he cannot be called upon to convict himself. The State has no right to this service from the medical attendant, any more than it has a right to demand from a Roman Catholic or other clergyman that he should make known to the legal authorities that someone has confessed to being the principal actor in some robbery or other crime. It is right for them to demand that all men acting for any authority, or on behalf of any association, such as a dispensary or club, should give immediate notification to the medical officer of health; and the authority should also have power to pay the medical attendant a proper fee for the information when conveyed by them, and when made with the consent of the private employer, but it is the use of might, not right, under other circumstances, and in consequence it is not successful in the object proposed to be attained. There is no doubt, however, that every householder or other person responsible for the care of a patient suffering from infectious disease should give notice to the local authority of the presence of such disease in his household; it is also without doubt that the medical man is the best person to forward the notification. A general law compelling the notification and allowing the medical man to give the information, with the consent of his employer, and a fair fee for the information being paid by the local authority, would ensure a much greater chance of general notification than under the dual plan so much in favour with medical officers of health and others who do like to have a legal power over those with whom they come in contact. It is not surprising that medical officers of health like to possess this power, as it gives them much less trouble, but, for the sake of a noble profession, I object to have penalties put upon the members of it, if they do not perform an act which the State has no true right to demand from them under any circumstances, except those I have indicated.

My task is almost finished. It is the duty of managers of all schools, and the heads of all establishments, to see that the wear and tear of nerve force is not in excess of its power to repair. This repair takes place most certainly during *sleep*. If the time for sleep is not afforded by those in authority it will either be taken surreptitiously, or the nervous system will suffer to the detriment of the work to be performed. Very young children should go to bed soon after sunset, and need not be roused until it is light again. Younger school children require more sleep than those who are older. If it be arranged for those of eight years of age to rise with those who are 16, the rules are wrong. Those at 16 may do with eight hours upon an average, but those at eight should have ten hours. The best provocative for sleep is muscular tiredness. Students who neglect the active use of their muscles will break down sooner or later, and not make that mark in the world which their position in the examination lists seemed to point out as their actual right. It is the athlete and muscular man, who having distinguished himself in the schools makes the healthier and nobler man in later life. Brain work must be balanced by muscle work to preserve health. The action of muscle utilises the *debris* of brain action, men who balance the one by the other do not suffer from those bilious and dyspeptic conditions which belong to men who neglect the laws of health. It is impossible for a man to be healthy and to enjoy his life unless he conforms to the laws of nature. If such an one is sleepless, let him shut up his books and take to spade labour. It is useless to expect to get health by walking. The violent disturbance on the one side requires a corresponding violence on the other to bring things round. It is necessary to bring into play other muscles than those which are used in genteel walking. Spade labour, strong horse exercise, tree cutting, and other similar occupations will, if regularly continued, with abundance of pure water, bring refreshing sleep in a much more satisfactory manner than any effects to conteract sleeplessness by digestive tablets or narcotic means. If these latter be adopted, the patient is on the high road to serious break down. Hard labour and simple fare will always succeed in the long run, the other means I have named, never. Six hours sleep in summer, seven in winter, is ample allowance for an adult man, rather more for the woman. Excess of sleep is not to be encouraged, as it leads to slothfulness, and muscular weariness. There are evils in excess of any kind which apply to the searchers after health as well as to those who follow their own lusts. Let me conclude with the motto—

Hic patet ingeniis campus certusque merenti.
Stat favor: ornatur propriis industria donis.

—o—

Easy Steps in Trigonometry.

BY REV. A. D. CAPEL, M.A.,

Author of 'Catch Questions in Arithmetic,' etc., etc.

ANSWERS AND HINTS TO SOLUTIONS.

CHAPTER XIV.

1. Let AB (height H) and CD (height h) be the two towers, of which AB is the higher. BD = 156 ft. Bisect BD in E. The triangles CDE and EBA are known to be equiangular,

$$\therefore Hh = 78^2 \ldots\ldots \text{i.}$$

$$\frac{H}{156} = \tan ADB = \tan 2\,CBD = \frac{\frac{2h}{156}}{1 - \frac{h^2}{156^2}} \ldots\ldots \text{ii.}$$

substitute from i. value of H, and solve in h.

2. Let AB (height 144 feet) and CD (height h) be the tower and the column.
Through C draw CE parallel to DB.

$$CE = AE.$$

$$\text{and CE or DB} = \frac{144}{\sqrt{3}}$$

$$\therefore \frac{144}{\sqrt{3}} + h = 144$$

$$\therefore h = (144 - 48\sqrt{3}) \text{ feet.}$$

3. Let C be the spot where the tree is,
Let CAB = 60° and CBA = 45°
Let CD (length d) = breadth of stream, and let AD = x.
Get two expressions for d and equate, solve equation in x.

$$\text{Ans. } d = \frac{100}{1 + \frac{1}{\sqrt{3}}} \text{ or } 50(3 - \sqrt{3}).$$

4. Let C be the fortress, and A and B the spots where the observations were made.

In the triangle CAB, we know CAB = $22\frac{1}{2}°$; CBA = $112\frac{1}{2}$ and ∴ ACB = 45° and AB = 4 miles.

$$AC = \frac{\sin 112\frac{1}{2}}{\sin 45°}. \ 4 \text{ miles.}$$

$$\sin 112\tfrac{1}{2} = \sin 67\tfrac{1}{2} = \cos 22\tfrac{1}{2} = \tfrac{1}{2}\sqrt{2+\sqrt{2}}.$$

$$\text{Ans. } AC = \sqrt{16 + 8\sqrt{2}} \text{ miles.}$$

5. To draw this figure accurately the student may take any horizontal line AB, at B make the angle ABC = 45°, at C make the angle BCA = 30°, meeting AB in A. C will be the point of observation, A the first position of the ship, and B the second. AB = 15 miles.

$$\text{then } AC = \frac{\sin 45°}{\sin 30°}. \ 15 \text{ miles.}$$

$$\text{Ans. } 15\sqrt{2} \text{ miles.}$$

6. Ans. $\tan^{-1}\frac{1}{2}$.

7. Let PQ (height h) be the tower.

$$QA = h. \quad BQ = \sqrt{a^2 + h^2}$$

$$\frac{h}{BQ} = \tan 30° = \frac{1}{\sqrt{3}}$$

$$\therefore \frac{h^2}{a^2 + h^2} = \frac{1}{3}$$

$$\text{and } h = \frac{a}{\sqrt{2}} \text{ or } \tfrac{1}{2}a\sqrt{2}.$$

8. Draw a horizontal line AA^1 and a vertical line BB^1 intersecting in O. B and B^1 both north of AA^1.

At any point A, west of O, form the angle OAB = $22\frac{1}{2}°$ B north of OA. Produce AB to C. At B make the angle CBA_1 = 45°, meeting AO in A_1, from A_1 drop A_1C perpendicular to AC and produce it to meet OB in B_1.

∴ ACA_1 and B_1CB are equal in all respects.

$$AB = AC - BC$$

$$= 4 \sin 67\tfrac{1}{2}° - 4 \sin 22\tfrac{1}{2}° \text{ miles}$$

$$= 2 \cos 45°. \sin 22\tfrac{1}{2}°. \ 4 \text{ miles.} \qquad \text{Form. D.}$$

$$= 2. \frac{1}{\sqrt{2}}. \tfrac{1}{2}\sqrt{2-\sqrt{2}}. \ 4 \text{ miles.}$$

$$= \sqrt{16 - 8\sqrt{2}} \text{ miles.}$$

9. Let D be the position of the balloon, and E the spot on the plain exactly underneath it. Call DE = h. See par. 200.

Ans. $\sqrt{\frac{3}{2}}$. 100 yds.

10. Let AB be the tower, C the position of the man's eye, and D the mark in the tower, so that AD = 26 feet and DB = 25 feet. Through C draw CF horizontally meeting the tower in F

$$\sin CDA = \sin CDB. \qquad \text{Form. 17.}$$

$$\text{and } \sin ACD = \sin DCB.$$

$$\therefore \frac{CA^2}{CB^2} = \frac{26^2}{25^2} = \frac{CF^2 + 46^2}{CF^2 + 5^2}$$

$$\therefore CF = 160 \text{ feet.}$$

11. The greatest angle of elevation is when the tower is nearest to the observer.

Let B be the foot of the tower (height h), C and D the points of observation 200 and 100 yards respectively from E, the point of intersection of the roads.

$$BC = \frac{h}{\sqrt{3}} \text{ and } BD = h.$$

$$BE^2 = 200^2 + \frac{h^2}{3} = 100^2 + h^2$$

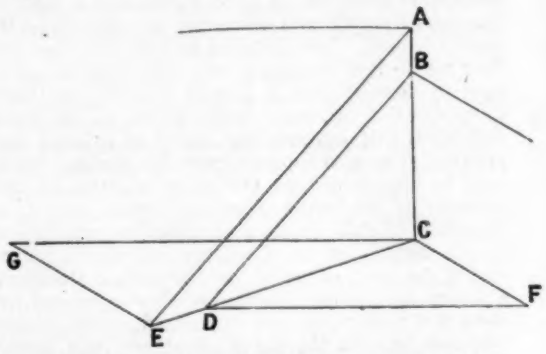
$$\text{whence } h = 150\sqrt{2}.$$

12. Ans. $50\sqrt{3}$ ft.

13. If AB be the tower and C D the places of observation. BC = 100 feet and BD = $100\sqrt{3}$ feet ∴ the angle of elevation at D is $\tan^{-1}\frac{100}{100\sqrt{3}}$ or 30°.

14. $h = 100.\sqrt{2}.\sin 54°$.

15.



Let ACG (AC = 50 ft.) and BCF (BC = 40 ft.) be the two walls, and let CDE be the meridian through their section.

Let BD and AE be the paths of two rays of the sun.

Let DF (60 ft.) be perpendicular to CF.

and EG (70 ft.) " " " CG.

Let DCF = θ, and BDC or AEC = ϕ

DF or 60 = DC sin θ,

and DC = BC cot ϕ or 40 cot ϕ,

∴ 60 = 40. cot ϕ. sin θ.....i.

Again GE or 70 = CE cos θ,

and CE = 50 cot ϕ,

∴ 70 = 50. cot ϕ cos θ.....ii.

i. ÷ ii. $\tan\theta = \frac{60}{70}.\frac{40}{50}$ or $\frac{12}{14}$

∴ $\theta = \tan^{-1}\frac{12}{14}$ or very nearly 46°.

16. Let PAB be a horizontal line.

Let P be the position of the object and A the foot of the hill, and let PA = d.

Let AC represent the hill at an angle $x°$ to the horizon, measure along AC. AD = DE = c feet. Join PD, PE.

Then PDA = $(x - A)°$ and PEA = $(x - B)°$.

From triangle DPA, $\frac{c}{d} = \frac{\sin A}{\sin(x - A)}$

and from triangle EPA $\frac{2c}{d} = \frac{\sin B}{\sin(x - B)}$

equate values of $\frac{c}{d}$, expand sin $(x - A)$, &c., and divide by sin A sin B.

17. Ans. $\frac{c \sin(x - A)}{\sin A}$.

18. Let A and C be the points of observation.

Let AB drawn N.N.W., and CB drawn due N. meet in B, then CBA = $22\frac{1}{2}°$.

Let AD drawn W.N.W. and CD drawn N.W. meet in D, then CDA = $22\frac{1}{2}°$, hence a circle can be described about ACDB. Since ACD = 90°. ∴ DBA = 90°. ∴ B is E.N.E. of D. Ans.

19. DB = BA and BA = $\frac{\sin 45°}{\sin 22\frac{1}{2}°}$. 5 miles.

20. If l = length of the flagstaff CD, and A and B the spots where the angles A and B are observed, and $x°$ the angle required, we have

$$\frac{l}{a} = \frac{\sin A}{\sin(x - A)} \text{ and } \frac{l}{b} = \frac{\sin B}{\sin(x + B)}$$

equating values of l, expanding and reducing

$$\frac{a}{\sin x \cot A - \cos x} = \frac{b}{\sin x \cot B + \cos x}$$

hence we can easily find

$$\cot x = \frac{b \cot A - a \cot B}{a + b}. \text{ Ans.}$$

21. The student is referred to par. 199.
Let AB represent the stick (length l), and BC the section of the plane and a horizontal one, and let AC be perpendicular to BC. At A insert a pin (length p) perpendicular to the horizontal plane through BC.

If x = angle of inclination $\sin x = \frac{p}{AC}$ but $p = l \cos A$ and $AC = l \sin B$.

$$\therefore x = \sin^{-1} \frac{\cos A}{\sin B}.$$

22. Let D be the spot where the second observation is taken, let $CD = x$. Since $ADC = 45°$ we have this equation to find x

$$\frac{x}{x + 100} = \frac{1}{\sqrt{3}}$$

whence $x = 50(\sqrt{3} + 1)$ Ans.

23. Let A and B be the points of observation, through A draw AE a horizontal line meeting CD (the obelisk) produced in E and let $DAE = x$

$$\frac{CB}{a} = \frac{\sin A}{\sin (B - A)} \text{ and } \frac{CB}{h} = \frac{\sin CDB}{\sin B}$$

but $\sin CDB = \sin ADE = \cos x$.
Substituting and equating values of CB we prove our proposition.

24. Let the perpendicular from C meet AB in D. Let $AD = x$ and $DB = 65 - x$.

$\therefore x(65 - x) = 30^2$ $\therefore x = 20$ or 45.

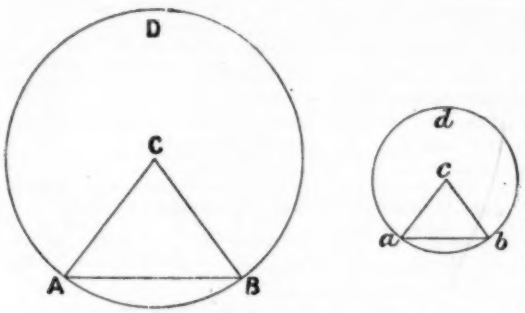
and $AC = \sqrt{20^2 + 30^2}$ or $10\sqrt{13}$.

25. $CBA = \tan^{-1} \frac{3}{2}$.

CHAPTER XV.

CIRCULAR MEASURE.

207. Before defining circular measure it is usual to give a proof of the well known proposition, that the circumferences of circles vary as their diameters, that is, that the ratio which the circumference of any circle bears to its diameter is a constant number.



208. Let DAB (centre C, Radius R) and dab (centre c, radius r) be any two circles. Let AB ab be the sides of similar regular polygons inscribed in the circles DAB, dab—

$\therefore$ The angle ACB = angle acb, and the triangles CAB and cab are similar.

$\therefore$ AB : R = ab : r.

Similarly with regard to the other sides of the two polygons.

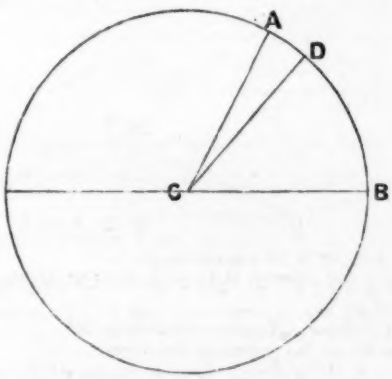
$\therefore$ perimeter of polygon inscribed in DAB : R = perimeter of polygon inscribed in dab : r

If the number of the sides of the polygon be indefinitely increased and their lengths correspondingly diminished, we can make the difference between the perimeters of the polygons and the circumferences of the circles, in which they are inscribed, less than any assignable quantity.

$\therefore$ Circ. of DAB : R = circ. of dab : r
and $\therefore$ circ. of DAB : 2R (or diameter)
= circ. of dab : 2r (or diameter)
which proves our proposition.

This constant ratio (noted by π) cannot be found exactly; approximately it is $\frac{22}{7}$ or $\frac{355}{113}$ or 3·14159...

209. Euclid VI. 33, proves that the angles at the centre of a circle have the same ratio which the arcs on which they stand have.



Let ACB DCB be two angles at the centre of the circle ADB.

Let the arc AB = radius CB.

$\therefore$ Angle DCB : angle ACB = arc DB : radius.

If we consider the angle ACB the unit of our angular measurement we have angle $DCB = \frac{\text{arc DB}}{\text{rad.}}$

or any ang. $= \frac{\text{arc subtending it}}{\text{radius}}$.

210. From what has been shown in 209.

$$2 \text{ right angles or } 180° = \frac{\text{semicircumference}}{\text{radius}}$$
$$= \frac{\text{circumference}}{\text{diameter}} = \pi \quad (208)$$

211. Let θ be the circular measure of an angle containing D°.

$$\therefore \theta : \pi = D° : 180°$$
$$\therefore \theta = \frac{\pi}{180} D$$

e.g. If $D = 60°$

$$\theta = \frac{\pi}{180} \cdot 60 = \frac{\pi}{3}$$

212. Similarly $\theta = \frac{\pi}{200} G$

e.g. If $G = 40^g$

$$\theta = \frac{\pi}{200} \cdot 40 = \frac{\pi}{5}$$

213. If we know the lengths of the arc and of the radius of the circle, we can find the circular measure of the angle at the centre on which the angle stands, and from that the number of degrees or of grades in it.

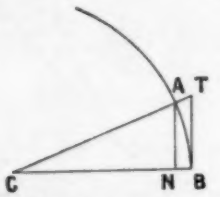
214. If the radius of the earth be considered to be 4000 miles, what angle subtends an arc 100 miles in length.

If θ = circular measure, D the number of degrees, and G the number of grades.

$$\theta = \tfrac{100}{4000} = \tfrac{1}{40}$$

$$\therefore\ D = \frac{180}{\pi}\cdot\tfrac{1}{40} = \frac{63^\circ}{44} = 1^\circ\ 25'\ 54{\cdot}5''\ldots\left(\pi = \tfrac{22}{7}\right)$$

215. Conversely if we know the angle and the radius, we can measure approximately the length of the arc.



216. Let ACB be a small angle.

From B draw BT at right angles to CB meeting CA produced in T.

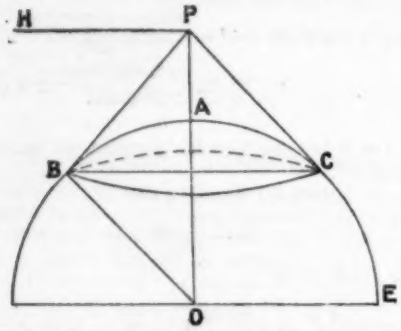
From A draw AN perpendicular to CB.

Referred to the radius of the circle

AN is the sine of the angle ACB
AB „ circular measure „
TB „ tangent „

And these are in order of magnitude, *i.e.* tan > θ (circular measure) > sine.

217. If this angle ACB be diminished without limit, these three, the tangent, the circular measure, and the sine, may be considered to become equal, and the ratio which any one of them bears to another may be considered = 1.



218. Let P be the point where an observer's eye is placed. Let BAC represent the earth's surface, O its centre, PA the height (h) of the observer's eye above the level of the sea, PB, PC tangents from P to the earth. If HP be horizontal, the angle HPB (= POB) is called the dip of the horizon. Let HPB = θ.

OP = OB sec θ, or OA sec θ.

$$\text{PA or } h = \text{OP} - \text{OA or OA}(\sec\theta - 1)$$

$$= \frac{\text{OA}(1 - \cos\theta)}{\cos\theta}$$

$$\therefore\ \text{OA} = \frac{h\cos\theta}{1 - \cos\theta}$$

$$\text{Again PB} = \text{OB}\tan\theta$$

$$= \frac{h\cos\theta}{1 - \cos\theta}\tan\theta$$

$$= \frac{h\sin\theta}{1 - \cos\theta} = \frac{2h\sin\frac{\theta}{2}\cdot\cos\frac{\theta}{2}}{2\sin^2\frac{\theta}{2}}$$

$$= h\cot\frac{\theta}{2}.$$

219. Using the same figure as in 218.

$$PB^2 = h(h + 2.AO) \quad \text{Eucl. iii. 36.}$$

Since in practice h must be very small compared with 2AO {*e.g.* 6 miles (higher that the highest mountain) : 8,000 miles} we may neglect h^2 altogether.

Hence if we consider the radius of the earth 3960 miles (which it very nearly is) we have $PB^2 = 2.h.3960$; or $(PB \times 1760 \times 3)^2 = 2.h.3960 \times 1760 \times 3$ when PB is expressed in miles and h in feet.

$\therefore$ PB^2 miles $= \frac{3}{2}h$.

If $\therefore$ h = 12 ft., PB = $3\sqrt{2}$ miles.

Or if a spectator's eye is 12 feet from the surface of a lake he can see the water for a distance of 4·2426... miles all round him.

220. To expand $\sin x$ in terms of x, x being the circular measure of the angle.

Let $\sin x = a + bx^\beta + cx^\gamma + dx^\delta + \ldots$, where a, b,... and β, γ,... are at present unknown.

(i.) β, γ,... can only be integral, for if one of them were a fraction we should have more than one value for $\sin x$ which is not possible.

(ii.) β, γ,... cannot be negative; for if the index of a single term even were negative, we should have, when $x = 0$; $0 = \infty$, which is impossible.

For x write $-x$.

$$\sin(-x) = a - bx^\beta - cx^\gamma - dx^\delta \ldots$$

$$\text{but } -\sin x = -a - bx^\beta - cx^\gamma - dx^\delta \ldots$$

but $\sin(-x) = -\sin x$

$\therefore$ these two series are equal, but this can only be when a = 0, and β, γ, δ,... are odd numbers.

$$\therefore \sin x = h_1x + h_3x^3 + h_5x^5 \ldots\ldots \quad \text{i.}$$

221. By similar reasoning we could prove that

$$\cos x = 1 + h_2x^2 + h_4x^4 + \ldots \quad \text{ii.}$$

222. To find the coefficients h_1, h_2...

Let $x = y + z$.

$\therefore$ $\sin x = \sin y\cos z + \cos y\sin z$ Form. 11.

and $\cos x = \cos y\cos z - \sin y\sin z$ Form. 12.

For $\sin y$ write $h_1y + h_3y^3$ from i.

and „ $\cos y$ „ $1 + h_2y^2 + h_4y^4$ from ii.

$$\therefore \sin x = (h_1y + h_3y^3\ldots)(1 + h_2z^2 + \ldots) + (1 + h_2y^2\ldots)(h_1z + h_3z^3\ldots)$$

$$\cos x = (1 + h_2y^2\ldots)(1 + h_2z^2\ldots) - (h_1y + h_3y^3\ldots)(h_1z + h_3z^3\ldots)$$

$$\text{again } \sin x = \sin(y + z) = h_1(y + z) + h_3(y^3 + 3y^2z + 3yz^2 + z^3) + \ldots$$

$$\text{and } \cos x = \cos(y + z) = 1 + h_2(y^2 + 2yz + z^2) + \ldots$$

Equating the coefficients of 1st powers of y, in these two series of sin x and of cos x.

$h_1 + h_1h_2z^2 + h_1h_4z^4 \ldots = h_1 + 3h_3z^2 + 5h_5z^4 \ldots$ iii.

$-h_1^2z - h_1h_3z^3 - h_1h_5z^5 \ldots = 2h_2z + 4h_4z^3 + 6h_6z^4 \ldots$ iv.

223. Since $\sin x = h_1x + h_3x^3 + h_5x^5 \ldots$

$$\therefore \frac{\sin x}{x} = h_1 + h_3x^2 + h_5x^4 \ldots$$

but when $x = 0$; $\frac{\sin x}{x} = 1$

$$\therefore h_1 = 1.$$

224. Equating coefficients of powers of x in iii. and iv.

$$2h_2 = -h_1^2 \quad \therefore h_2 = -\frac{h_1^2}{2} = -\frac{1}{2}$$

$$3h_3 = h_1h_2 \quad \therefore h_3 = -\frac{1}{2 \cdot 3}$$

$$4h_4 = -h_1h_3 \quad \therefore h_4 = \frac{1}{2 \cdot 3 \cdot 4}$$

$$5h_5 = h_1h_4 \quad \therefore h_5 = \frac{1}{2 \cdot 3 \cdot 4 \cdot 5}$$

$$6h_6 = -h_1h_5 \quad \therefore h_6 = -\frac{1}{2 \cdot 3 \cdot 4 \cdot 5 \cdot 6}$$

and so on.

$$\therefore \sin x = x - \frac{x^3}{1 \cdot 2 \cdot 3} + \frac{x^5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5} - \frac{x^7}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7} + \ldots$$

$$\cos x = 1 - \frac{x^2}{1 \cdot 2} + \frac{x^4}{1 \cdot 2 \cdot 3 \cdot 4} - \frac{x^6}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6} + \ldots$$

225. EXAMINATION AND EXAMPLES, XV.

1. C.M. is an abbreviation for Circular Measure. Let $\pi = 3\frac{1}{7}$. What do you understand by the unit of Circular Measure, and how many degrees does it contain?

2. How many degrees are there in an angle whose C.M. is 2.5?

3. What is the C.M. of an angle which contains 25°?

4. The same mixed number expresses the three angles of a triangle in degrees, grades and C.M. respectively; find them.

5. One angle of a triangle is π grades, another is π degrees; find the C.M. of the third.

6. If the radius of a circle is $2\frac{1}{2}$ feet, find the length of the arc on which an angle containing 25° stands.

7. Find the circular measure of an angle in which the number of grades is equal to the number of degrees in its complement.

8. If the unit of angular measurement be $\frac{\pi}{16}$. Find the number of degrees in the angle expressed by 5·09296.

9. If the circumference of a circle be divided into n equal parts, how many of them would an arc equal to the radius contain?

10. Two wheels with fixed centres roll upon each other, and the circular measure of the angle through which one turns gives the number of degrees through which the other turns in the same time. Compare the radii of the wheels.

11. What is the length of a degree of longitude at latitude 60° if the Earth's radius be 4000 miles.

12. At what latitude is the length of a degree of longitude 49·38523 miles.

13. How many miles does the earth go in its orbit (supposed circular) round the Sun in 1 second, if its distance from the Sun be 94,000,000 miles.

14. Find the length of the arc subtended by an angle whose C.M. is $\frac{\pi}{4}$ in a circle whose radius is 12 feet.

15. Prove that if θ be the C.M. of an angle $< 90°$; Sin θ lies between θ and $\theta - \frac{\theta^3}{4}$.

16. At what distance does a man 6 ft. high subtend an angle of 30″?

17. What would the formula $\theta = \frac{\text{arc}}{\text{radius}}$ become, if the unit of circular measure were 36°?

18. If the unit of measurement were the $\frac{1}{100}$ of a right angle, how many such units would there be in an angle whose C.M. is 4·716?

19. Find approximately the distance of a tower whose height is 51 feet and which subtends at the eye an angle of $\frac{60'}{11}$.

20. How many miles can an observer see, who is on an eminence 5 miles above the sea level.

21. Show that the area of a circle is π (radius)^2.

22. Express in C.M. the angle which is subtended at the centre of a circle, 3 square inches in area, by an arc of 1 inch.

23. Prove $\sin a = \frac{1}{2}\sqrt{1 + \sin 2a} \pm \sqrt{1 - \sin 2a}$

24. Prove $\cos a = \frac{1}{2}\sqrt{1 + \sin 2a} \mp \sqrt{1 - \cos 2a}$

25. Prove $\tan x = x + \frac{2x^3}{1 \cdot 2 \cdot 3} + \frac{2^4x^5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5} + \ldots$

(To be continued.)

Animal Physiology.

BY ARTHUR NEWSHOLME, M.D., AND C.S.S. (LOND.)

THE SKIN.

THE skin is one of the most complex structures in the body, and as such performs a variety of functions. The extent of the cutaneous surface in a good-sized man is equal to a little more than sixteen square feet (Sappey). The thickness of the skin varies greatly in different parts. Where much friction and pressure is experienced, it becomes very much thickened, but its usual thickness is from $\frac{1}{12}$ to $\frac{1}{8}$ inch, while in very sensitive parts it may not be more than $\frac{1}{100}$ inch.

Structure of Skin.

The skin is naturally divided into a superficial layer, variously known as the scarf-skin, cuticle, or epidermis; and a deeper layer, called the true skin, cutis, or corium. The true skin is connected to the subjacent parts by

connective tissue, in which is embedded a variable amount of fat, except in the skin of the eyelids, &c. The thickness of the subcutaneous fatty layer varies greatly according to the nutrition of the individual.

The Corium.

The true skin or corium consists of interlaced connective tissue fibres, blood-vessels and lymphatics, and the lower terminations of the glands of the skin. In addition it contains a number of unstriped muscle fibre cells, especially near the hair-follicles, which. when excited by cold or other stimuli, cause the hair follicles to project and produce the appearance known as 'goose-skin.'

The part of the corium in contact with the epidermis is projected at intervals in the form of conical papillæ, which serve as special organs of touch. The papillæ

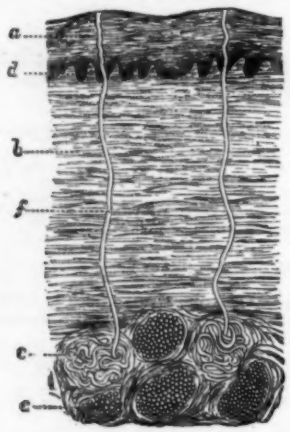


Fig. 55.

Vertical Section of Skin.

a, Epidermis. *b*, Dermis. *d*, Papillæ. *f*. Sudoriparous tube. *c*, Coiled up termination of sudoriparous gland. *e*, Adipose tissue.

are arranged in ridges which form lines, and the epidermis is thinnest over them. The corium is abundantly supplied with blood-vessels and lymphatics, which reach as far as the papillæ, but do not penetrate the epidermis. The nerves of the corium end chiefly in the papillæ, but some minute branches terminate in the deepest cells of the epidermis.

The Epidermis.

The epidermis consists entirely of minute cells. Its external surface is marked by shallow grooves, which correspond to the furrows between papillæ. Its internal surface follows closely the undulations of the surface of the corium. (See fig. 55). The epidermis is usually divided into a superficial or horny part, and a deeper or Malpighian layer (rete mucosum). The cells of the horny layer are hard and flattened, measuring from $\frac{1}{2000}$ to $\frac{1}{750}$ inch in diameter. The deeper cells are more nearly spheroidal and are nucleated. They also contain all the pigment which is present in epidermal cells. In the negro this layer of cells is nearly black. The superficial cells are constantly being shed, their place being apparently taken by the transformation of the deeper cells.

The functions of the epidermis will be evident from a consideration of its structure. It protects the subjacent vascular and sensitive parts, and prevents evaporation from the general surface of the skin (except at the sweat-pores).

Nails, hairs, and feathers are modified epidermic structures.

Nails grow from the root and from the subjacent bed, and are simply epidermis hardened and modified to protect the phalanges, and to serve for prehensile purposes.

Hairs are epidermic structures arising from an inverted portion of the epidermis. The bulbous termination of the root of the hair rests on a papillæ of the skin (fig. 56), and the remaining part of the root is surrounded by the inverted cutaneous structures of the sac in which the hair is contained.

Each hair is covered by a layer of imbricated scales, within which are elongated fibre-cells, and in many hairs also a central medulla of dark granules mixed with air-spaces. The difference in colour of hairs depends on the amount of pigment present. Sudden blanching of the hair, which has occurred in a few authenticated cases, is due to the medulla becoming filled with air globules, and not to a loss of pigment which is the ordinary cause of hair turning grey.

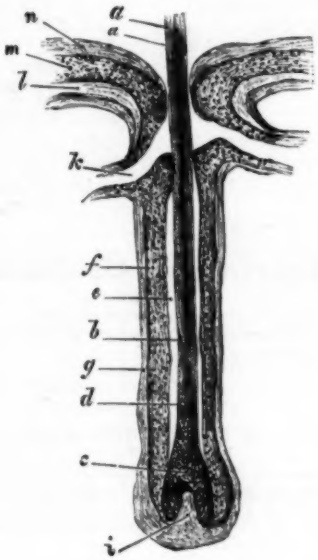


Fig. 56.

Vertical Section of Hair and Hair-follicle magnified 50 times.

a, Shaft. *b*, Root. *c*, Bulb. *d*, Epidermis of hair. *e*, Inner root-sheath. *f*, Outer root-sheath. *i*, Papilla of hair-follicle. *k*, Excretory ducts of two sebaceous glands. *l*, Cutis. *m*, Deeper; and *n*, Superficial layer of epidermis.

The number of hairs on the scalp has been estimated as about 1000 per square inch; on the entire head 12,000. Negative electricity is excited by friction of hair; and when they absorb moisture they become longer, hence the occasional use of them as hygrometers.

The hairs serve to protect the surface of the body from cold. The eyebrows prevent perspiration running from the forehead on to the eyelids; the eyelashes protect the surface of the eye from dust, &c., and the moustache similarly protects the lungs from dust.

Glands of the Skin.

The substance of the skin is perforated by the orifices of numerous glands, which are of two kinds, *sudoriparous* or sweat-secreting, and *sebaceous*.

On examining the surface of the skin with a low magnifying power, the orifices of sudoriparous ducts may be seen in the middle of the papillary ridges. In

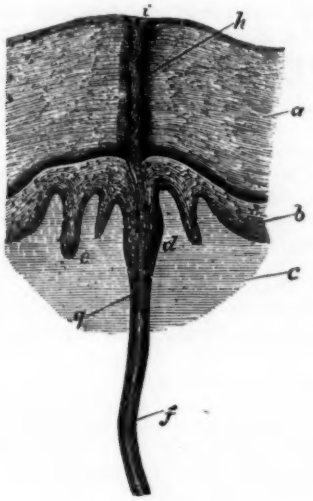


Fig. 57.

Section of Skin showing duct of Sudoriparous Gland magnified 50 times.

a, Horny part of epidermis. *b*, Rete mucosum. *c*, Corium. *d* and *e*, Papillæ of skin. *f* and *g*, Sudoriparous duct. *h*, Same in cuticle. *i*, Sweat-pore.

a section of the skin, such as that shown in Fig. 57, the ducts are seen passing through the epidermis and corium, to end in convoluted coils as seen in Fig. 58.

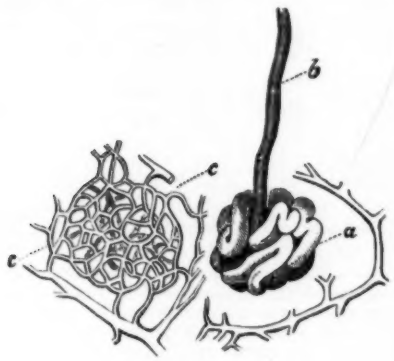


Fig. 58.

A Sudoriparous glandular coil and its blood-vessels magnified 35 times.

a, Coil. *b*, Duct. *c c*, Capillary vessels supplying the coil.

Various estimates have been made of the total number of sudoriparous glands. It is estimated by Krause that the total number is 2,381,248. Assuming that each coil when unravelled measures about $\frac{1}{10}$ inch, the entire length of the secreting tubes is about $2\frac{1}{3}$ miles. This does not include the length of the excretory ducts, which would increase the estimated length of tube to over 20 miles.

Sebaceous glands are found in all parts of the body that are provided with hair. They are short saccular glands, the duct of which may open into a hair follicle, or on to the surface of the skin. Their function is to secrete an oily matter, which lubricates the general surface of the skin and the hairs, and keeps the skin supple and free from harshness and dryness.

(To be continued.)

—o—

How to teach the Babies.

BY JAMES BAILEY.

Head Master of Southlands Training College.

CHAPTER VI.—(*continued.*)

'ORAL LESSONS.'

IT cannot be too strongly impressed on the Teacher's mind, that the value of these lessons will be proportionate to the degree in which they are made the *real*, vital, mental processes of teaching, not mere verbal exercises. They must be such as engage the actual, intelligent, exercise of the senses upon the object. The illustrations employed must be clearly explained, and, which does not always and necessarily follow, they must be clearly understood by the children. The descriptions must be *realized*, and, so far as may be, they must be interpreted by the little ones themselves in their own language. In no other way can the knowledge become the realized possession of each individual child. Here it is that the *manner* of the teacher in the delivery of the lesson has more to do with success than the mere technicalities of method, however accurate. For where the latter are relied upon exclusively, or even mainly, to the neglect of the free play of eye and voice, and the brightening of the teaching by the lively imagination of the teacher, there will surely result a mechanical monotony of lesson-giving, spiritless in itself, and deadening in its dull uniformity to the faculties of the children.

This is especially to be borne in mind when the teacher uses the notes of lessons prepared by another. Their use may be very great in helping to form, or to improve, the style of one's teaching, by the adoption of what has been found successful in the experience of another, but when they are used for the giving of lessons, they must ever be *naturalized* by being recast in the mould of the teacher's own thought, and vivified by those accompaniments of manner which give the charm of interest to the children.

Bearing this in mind, it may be useful to give a few outline notes of several kinds of lessons, together with illustrative specimens, in greater detail, of the style and language proper to the giving of them, so far as written representation makes it practicable.

It has already been pointed out that verbal sketches of lessons on the black-board are scarcely suitable at this early stage of teaching. If used at all, the words should be few in number, and clearly written in print-form. When the children can follow this it is a good plan to print in this way a few, short, simple, statements of facts which have been brought out in the lesson, and to let them be repeated by the class till thoroughly known. It will not be a vain repetition to emphasize at this point the statement previously made, that every Infant Teacher should familiarize herself with the use of the chalk and the blackboard, and cultivate the art of sketching rapidly and easily, simple outlines and forms of things which may be requisite for lesson illustration.

LESSONS FOR THE BABIES' CLASS.

Outline Notes.

A CHAIR.

THE teacher will show a chair, touching and naming each part as it is spoken of, closely connecting the lesson throughout with the illustration afforded by the chair. It will add to the clearness and effectiveness of all such lessons if simple outlines of things, or their parts, be drawn on the black-board.

I. *INTRODUCE* by speaking of the different kinds of things we have to do during the day, *walking, standing, working.* We are *tired* and *sit down*, sometimes we *lie down.* We stand, walk, and often work on our feet; we sit upon a *seat.* Speak of *various sorts of seats.* Names of these? *Stool, form, chair.* Which kind most used at school? at home? (*Revise.*)

Our lesson is to teach us something about—

II. *THE CHAIR.*—1. *How used;* for *sitting on.* But we do not always wish to sit in the same place. *Where we sit,* by *fireside,* by the *table,* near the *window,* or *door,* &c. How do we do this? By *moving the chair* from one place to another. It is *not fastened* to floor, or anything else.

2. *Its parts*—Each to be named and touched in succession. The *back,* the *seat,* the *legs; need, use,* and *form* of each part, how *fastened together.* It is made of wood; is *strong, light,* often prettily shaped. (*Revise.*)

III. *KINDS OF CHAIRS.*—The kind of chair depends on *place* of using, and *for what* used. Chairs for *kitchen,* for *parlour,* for *bedroom. Arm* chairs, *Easy* chairs, for sick, or tired, or old, people. Briefly describe each kind. (*Revise* and *Recapitulate* the whole lesson.)

If thought desirable, this might be written, as the lesson is given, as a—

BLACKBOARD SKETCH.

CHAIR	For sitting on.
HAS	BACK, SEAT, LEGS.
MADE of	WOOD, is LIGHT, STRONG.
KINDS of CHAIRS	KITCHEN, PARLOUR, BEDROOM, EASY CHAIRS, ARM-CHAIRS.

OUTLINE LESSON NOTES.

The Hen.

For illustration, have a good picture of the hen, or a real bird, or at least, some feathers, a head with bill, a foot, a wing.

I. GENERAL DECRIPTION.—By help of the picture and other illustrations, describe in simple language *the general form and parts.* The hen is a *bird.* Like all birds it has two *wings,* two *legs,* is covered with *feathers;* its mouth is a *bill* or *beak;* on each of its four toes it has a sharp, strong *claw.* It can *fly* and *run,* or *hop;* some birds can *swim.*

II. PARTS OF THE HEN (structure).—Chief parts three = *Head, Body, Legs.* Covered with *feathers.*

1. *Head,* general shape; *small, roundish, pointed,* at end is the *bill;* its two parts, upper, under; sharp, strong, &c., its *use? why* so shaped? *Eyes* two, where placed, *bright, quick to see,* &c. *Ears* two, where? small, nearly hid, can *hear quickly.*

2. *Body; its shape, size, covering.* The *feathers* are *soft, warm,* pretty in *shape* and *colour;* wings two, where? Can be *folded, spread abroad,* &c. Some of its feathers long, others short. *Use* of wings, *warmth, flight, covering* the young, &c. The *tail,* of *what made, shape, &c.*

3. *Legs; their shape, jointed, how covered. Toes* four; three in front, one behind; like a thumb. The claws *sharp, strong, curved, &c.*

III. HOW THE HEN LIVES. Where seen, farm yard, garden, hencoop, &c. Describe the pretty sight; the busy hen scratching up earth on rubbish heap, &c., how and why? Searching for food = *seeds, worms, insects, breadcrumbs, &c.* The group of little chickens, the noise they make, and the mother hen; their danger; her care of them.

The hen lays eggs. Some are *eaten.* On some she *sits. Why? Hatching;* describe the coming of the naked chicken; the growth of feathers, &c.

The hen and the eggs are used as food.

Revision at end of each section

FULL NOTES OF SAME LESSON.

Detailed as Specimen of Language and General Style of giving it.

It will be seen that though the order of arrangement is observed, the numbered headings are omitted, as they form no part of the lesson as given to the class.

Teacher shows picture or specimen. Here is a pretty picture, what do we call it? *A bird**—how do we know that? *Because it has wings. It is covered with feathers.* See now what every bird has (touching each part). Here is the?—*head.* This is the?—*body;* this, the?—*wings;* these are the?—*legs.* At the end of the head is the?—*bill.* What is the bill? *The bill is the hen's mouth.*† Let all

* The children should be encouraged to answer *collectively,* the easier questions, when the answer is obvious, and likely to be answered by a specific word, or phrase. When one child, or a few only give the answer, an effort should be made to get the rest to see and to give the answer, though not as a mere echo of the leading voices. Other questions should be addressed to individuals, or the children trained to lift the hand if they can answer, and the teacher select one or more to answer.

† Train the children, as far as practicable, to give for their answers, *complete sentences,* however simple in style and language.

repeat 'A bird's mouth is called a bill.' Has a bird teeth? *No.* Look at the bill, and touch it. It is *hard, smooth, sharp.* What do you do with your teeth? We *bite*, and *chew our food.* Can the bird bite with its bill? Can it chew? What can the bird not do with its bill? How does it get its food? *It pecks it up* (explain and illustrate this). How does it eat a piece of bread? *It pecks it in little bits.* How does it take up seeds? *(Revise at this point.)*

Then here are the eyes. How many are there? Where are they placed? *One on each side the head.* How bright and keen looking they are. How quickly it spies out the seed, or the crumbs of bread, or the little worm, or other things it eats. How quickly too it sees anything coming which would hurt it. Say now, what the quick sight of the bird does for it. *It shows it where to get its food. It shows it when anything would come to hurt it.*

What else may we find in the head? Here are its *ears.* Where are they? Like the eyes they are one on each side the head, but we can scarcely see them. Why is that? Because *they are so small,* and are *hid by the feathers.* But the sound can get in easily. How do we know that? Because they hear so quickly. Let us all repeat—*Birds see quickly and hear quickly.* Try to get near a little bird. What will it do? *It flies away.* Why is this? *Because it is easily frightened.* We say it is *timid.* The hen is not always timid. It is a *tame* bird.

Let us now see what we have learnt about the hen. What do we call it? How do we know it is a bird? What are birds covered with? How many legs has a bird? What kind of mouth? What can we do with our mouth which a bird cannot do? *We can chew our food.* What can birds do which we cannot do? *Birds can peck with their bill.* Why do most birds fly away when we go near them? Why does not the hen do so? *Because it is tame, &c.*

Look now at the body of the hen. How large and round it is. Where is it smallest? *Near the head.* Where is it largest? *Near the tail.* What is it covered with? Touch a feather. It is *soft,* and *smooth,* and prettily coloured. What is the colour? Are all feathers of the same colour? Some are red, some brown, some white, &c. So we say feathers are of different colours.

But what are these? *They are wings.* How many are there? What are they covered with? So there are *body feathers, wing feathers.* See how they spread open. Now they are *folded.* When does the hen spread her wings? When she wants to fly. Put your hand under the feathers. Now tell me what the feathers do for the hen? *Feathers keep the hen warm. (Revise as before.)*

Now we must learn something about the legs. How many are there? Where are they put? *The legs are under the body.* What do you do with your legs? *We stand on them.* What else do you do? *We walk and run about.* The hen does the same with her legs. In how many ways can the hen move? *She flies with her wings; she runs and walks with her legs.* What is this? It is a *joint.* What is the use of it? Has a little child any joints? What joints have you? Finger joints, elbow joints, &c. What is the use of the joints? Why are the hen's legs jointed? What is at the bottom of the leg? (Describe the shape, position of the toes, &c.) How many toes are there? Count them. One, two, three, in front. One behind. How many altogether? How many toes has a little boy?

Look now at the end of each toe. What is there? *A claw.* Touch it. It is hard, strong, very sharp. What shape is it? It is round and bent. What can the hen do with it? *The hen can scratch with her claws.* Let all repeat this, 'At the end of the hen's toe is a claw. The claw is round, strong, very sharp. The hen scratches with her claws.' Look at the end of your finger. What have you got there? *A nail.* It is hard, too, but not sharp. It is not round but flat. It keeps the finger from being hurt.

But where does the hen live? (Encourage the children to tell where they have seen them.) How pretty it is to see the hen and the little ones running about. What are the little ones called? The mother is a hen. The young one is a chicken. A chicken is a baby hen. What are they all doing? *They are scratching in the ground.* Hear the strange noise the hen makes. It is called *clucking.* Now she has found something. The little chickens all run to the mother. They know she is calling them, what has she found? A *seed,* a *worm,* a tiny little *beetle,* sometimes *crumbs of bread.* What do they do with it? *They peck it up and eat it.* What do we call that which we eat? *Our food.* Now what is the food of the hen? Where does she find much of it? How does she get it?

But sometimes the mother hen makes a different kind of noise, she clucks loud and quick. She stretches out her head, and spreads her wings. The chickens run to her faster than before, they push themselves under their mother's wing. What is the matter? There at the corner of the yard pussy has come round. She opens her great round eyes, what is she going to do? She is about to catch a little chicken. What would she do with it? She would carry it away and eat it. Now we know why the mother hen made such a noise, and why the little chickens all ran to her. Sometimes a strong fierce bird comes flying over the yard, with keen eyes and sharp claws. It is a *hawk,* and would like to catch the chicken. But the watchful mother hen makes the same noise, and her little ones run to her as before. But at times a poor little chicken cannot get there quick enough. What will happen then? (*Revise.*)

Sometimes the hen makes another sort of noise, she has been away in a quiet nest in the hen house. She comes out clucking with a loud noise. Go and peep quietly into the nest. What is there? A beautiful white egg. The hen has just laid it. What do we do with eggs? Eggs are eaten, put in puddings, cakes, etc.

All the eggs are not taken away to be eaten. Some are left in the nest, the mother hen sits on them day after day, keeping them warm. What is this for? Well, after many days, the egg shells crack open, and out of each, a little living chicken comes. It has only a few little feathers, it make a chirping noise; but it grows stronger, and larger, day by day, and grows up to be a hen like its mother; just as a little baby grows to be a boy or a girl, and after many years is a man or woman. (Revise the whole lesson, recapitulating its chief points in short simple sentences, to be repeated by the class.)

(To be continued.)

THE LITTLE SAILORS.

(ACTION SONG.)

Bold.
1. Oh, we are lit - tle jol - ly sai - lors, To the top - mast we can go;
2. 'Tis then we reef and lash the top - sails And when all is taut and trim,
Key C. Bold.
Hand o'er hand[1] we climb the rig - ging When the storm - y winds do blow.
Drink so snug - ly in our ca - bin[2] Tea from cups fill'd to the brim.

1 Move hand over hand as in climbing.

2 Hold right hand to lips as in drinking.

Pupil Teachers' Examination Papers,

OCTOBER 30TH, 1886.

QUESTIONS WITH MODEL ANSWERS.

Pupil Teachers at the end of the Fourth Year.

Three hours and a half allowed.

BOYS ONLY.

Euclid.

[All generally understood abbreviations or symbols for words may be used, but not symbols of operation, such as —, ×, +.]

(Answer *two* questions, including Question 3, if you can do so.)

1. If a side of a triangle be produced, the exterior angle is equal to the two interior and opposite angles; and the three interior angles of every triangle are together equal to two right angles.

Enunciate (without proving) the corollaries.

Book I. Proposition 32.

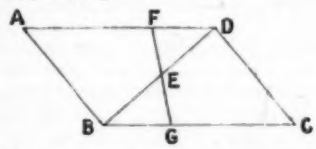
Corollary 1. All the interior angles of any rectilineal figure, together with four right angles, are equal to twice as many right angles as the figure has sides.

Corollary 2. All the exterior angles of a rectilineal figure made by producing a side at each angle are together equal to four right angles.

2. If a straight line be divided into two equal parts, and also into two unequal parts, the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

Book II. Proposition 5.

3. Any line drawn through the bisection of the diagonal of a parallelogram to meet the sides, is bisected at that point, and also bisects the parallelogram.



Let ABCD be a parallelogram, let its diagonal BD be bisected in the point E, and let the straight line FG be drawn through the point E to meet the sides of the parallelogram in F and G. Then the line FG is bisected in the point E, and it also bisects the parallelogram.

Because AD is parallel to BC and BD meets them, the angle FDE is equal to the alternate angle GBE (I. 29), and because FG meets the same parallels the angle DFE is equal to the alternate angle BGE (I. 29).

Therefore, in the two triangles DFE, BGE, the two angles FDE and EFD of the one are equal to the two angles GBE, EGB of the other, each to each; also the side DE is equal to the side EB (Hyp.).

Therefore, the side EF is equal to the side EG. (I. 26.)

That is, the line EG is bisected in the point E.

Also, the side FD is equal to the side GB.

And because in the two triangles FDE, GBE, the two sides FD, DE are equal to the two sides GB, BE, each to each, and the included angles FDE, GBE are equal: therefore the two triangles FDE and GBE are equal to one another. (I. 4.)

Again, because ABCD is a parallelogram and BD is its diagonal BD bisects it, that is, the triangle ABD is equal to the triangle CDB. (I. 34.)

From the two equal triangles ABD, CDB take the equal parts FDE, GBE; therefore the remainder ABEF is equal to the remainder CDEG. (Ax. 3.)

To the equal rectilineal figures ABEF, CDEG add the equal triangles GBE, EFD: therefore the whole ABGF is equal to the whole CDFG. (Ax. 2.)

That is, the parallelogram ABCD is bisected by the line FG.

[Q. E. D.]

Algebra.

(Answer *two* questions, including Question 2, if you can do so.)

1. Resolve into factors—

$a^2+3a+ac+3c$; $x^2+mxy-4xy-4my^2$; $a^2+49ab+600b^2$.

(1) $a^2+3a+ac+3c = a(a+3)+c(a+3) = (a+c)(a+3)$.

(2) $x^2+mxy-4xy-4my^2 = x(x-4y)+my(x-4y) = (x-4y)(x+my)$.

(3) Here we have to find as co-efficients of b two numbers, whose sum is 49, and product 600. These we find by inspection to be 24 and 25.

$\therefore a^2+49ab+600b^2 = (a+24b)(a+25b)$.

$(a+c)(a+3)$; $(x-4y)(x+my)$; $(a+24b)(a+25b)$. Ans.

2. Show that the least common multiple of two expressions may be found by dividing their product by their greatest common measure.

Find the L.C.M. of $x^2-10x+24$; $x^2-8x+12$; x^2-6x+8; and

Simplify $\dfrac{x-3}{x^2-10x+24} - \dfrac{2x-5}{x^2-8x+12} + \dfrac{x-7}{x^2-6x+8}$

Let the two expressions be A and B, and let their greatest common measure be m.

Suppose $A = mx$, and $B = my$, where x and y have no common factor.

Then the product $AB = m^2xy$.

But the least expression which will exactly contain mx and my, x and y having no common factor, is mxy, and mxy is obtained by dividing the product m^2xy by m, that is $mxy = \dfrac{m^2xy}{m} = \dfrac{AB}{m}$.

Hence the least common multiple of any two expressions may be found by dividing their product by their greatest common measure.

$x^2-10x+24 = (x-4)(x-6)$
$x^2-8x+12 = (x-2)(x-6)$
$x^2-6x+8 = (x-2)(x-4)$

$\therefore$ L.C.M. of these expressions $= (x-2)(x-4)(x-6)$

$$\frac{x-3}{x^2-10x+24} - \frac{2x-5}{x^2-8x+12} + \frac{x-7}{x^2-6x+8}$$
$$= \frac{x-3}{(x-4)(x-6)} - \frac{2x-5}{(x-2)(x-6)} + \frac{x-7}{(x-2)(x-4)}$$
$$= \frac{(x-3)(x-2)-(2x-5)(x-4)+(x-7)(x-6)}{(x-2)(x-4)(x-6)}$$
$$= \frac{x^2-5x+6-(2x^2-13x+20)+x^2-13x+42}{(x-2)(x-4)(x-6)}$$
$$= \frac{28-5x}{(x-2)(x-4)(x-6)}.$$ Ans.

3. Solve the equations:—

(1) $ax-by=c$, $cx-ay=b$

(2) $(3x-5)(2x-5) = x^2+2x-3$.

(1) $ax-by=c$ (m)
$cx-ay=b$ (n)

Mult. (m) by a $\therefore a^2x-aby = ac$ (o)
Mult. (n) by b $\therefore bcx-aby = b^2$ (p)
Subt. $(o)-(p)$ $\therefore (a^2-bc)x = ac-b^2$

$$\therefore x = \frac{ac-b^2}{a^2-bc}$$

Mult. (m) by c $\therefore acx-bcy = c^2$ (q)
Mult. (n) by a $\therefore acx-a^2y = ab$ (r)
Subt. $(q)-(r)$ $\therefore (a^2-bc)y = c^2-ab$

$$\therefore y = \frac{c^2-ab}{a^2-bc}$$

$x = \dfrac{ac-b^2}{a^2-bc}$, $y = \dfrac{c^2-ab}{a^2-bc}$. Ans.

(2) $(3x-5)(2x-5) = x^2+2x-3$

Remove brackets, $\therefore 6x^2-25x+25 = x^2+2x-3$

Subtract from each side $x^2+2x+25$

$\therefore 5x^2-27x = -28$

$\therefore x^2-\frac{27}{5}x = -\frac{28}{5}$

Complete square $\therefore x^2-\frac{27}{5}x+(\frac{27}{10})^2 = \frac{729}{100}-\frac{480}{100} = \frac{169}{100}$

Extract root $\therefore x-\frac{27}{10} = \pm\frac{13}{10}$

$$\therefore x = \frac{27\pm13}{10} = \frac{40 \text{ or } 14}{10} = 4 \text{ or } 1\tfrac{4}{5}.$$

$x = 4$ or $1\frac{4}{5}$. Ans.

Mensuration.

(Answer *one* question.)

1. State the rule for finding the area of a sector of a circle, and find the angle of a sector whose area is the same as that of a circle whose diameter is one-sixth the diameter of the sector's circle.

To find the area of a sector of a circle—first, when the radius and the length of the arc are given.

Multiply half the length of the arc by the radius.

Second, when the radius and the number of degrees in the arc are given.

Multiply the square of the radius by 3·1416 to find the area of the complete circle, then multiply this by the number of degrees and divide by 360.

The areas of circles vary as the squares of their diameters; hence if the diameter of one circle be six times that of another, the area of the larger circle will be 36 times the area of the smaller one.

Therefore the sector equal in area to the smaller circle is $\frac{1}{36}$ of the larger circle, and the number of degrees it contains $= \frac{1}{36}$ of $360 = 10°$.

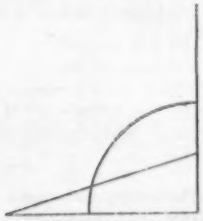
10 degrees. Ans.

2. A ladder 10 feet long is gradually raised against the wall, its ends being in contact with the wall and the ground. Find the radius of the circle described by its middle point as it is being raised. Also, when its upper end is seven feet above the ground, find to four places of decimals the distance of the lower end from the wall.

Since the ends of the ladder are in contact with the wall and the ground while it is being gradually raised, the ladder through every variation of its position from the horizontal to the perpendicular forms the hypotenuse to a right-angled triangle formed by the wall and the ground.

The hypotenuse of a right angled triangle is also the diameter of the circumscribing circle, and hence with the middle point of the ladder as a centre in every position of the ladder a semicircle may be described passing through the angle formed by the meeting of the wall and the ground. That is,

the middle point of the ladder is in every position equally distant from that angle, and its distance from that point is equal to half the length of the ladder, that is half of 10 feet = 5 feet.



Hence if a quarter of a circle be described with a radius of 5 feet from the angle where the wall and ground meet, it will give what is called the *locus* of the middle point of the ladder.

Distance of foot of ladder from wall when the top is 7 feet from ground $= \sqrt{(10^2 - 7^2)} = \sqrt{100 - 49} = \sqrt{51} = \underline{7{\cdot}1414}$ feet.

	51 (7·1414
	49
141	200
1	141
1424	5900
4	5696
14281	20400
1	14281
142824	611900
	571296
	40604

Radius 5 ft.; 7·1414 ft. Ans.

GIRLS ONLY.

Arithmetic.

1. An investor who had 150 £10 shares allotted to him in a brewery which was paying 3 per cent. per annum, sold them out when they were quoted at £1½ premium and invested the money in the Russian Five per Cents. at par. How was his income affected by the transfer?

Income from brewery shares = 3 per cent. on £1,500 = £45.
Selling price of brewery shares = £10 + £1½ = £11½ each.
∴ ,, 150 ,, = £11½ × 150 = £1,680.
Income from Russian Five per Cents. at par = £1,680 ÷ 20 = £84.
∴ Income would be increased by £84 − £45 or £39.
£39 increase. Ans.

2. A mechanic who is paid monthly, receives on pay-day £5 8s. 9d. less than his full wage, the difference being caused by his having received an advance a fortnight before. Supposing in such a case the employer reckons as if the rate of interest were 10 per cent. per annum, find the sum advanced.

Interest for 1 year at 10 per cent. per annum = $\frac{1}{10}$ of principal.
∴ Interest for a fortnight at 10 per cent. = $\frac{1}{26}$ of $\frac{1}{10}$ = $\frac{1}{260}$ of principal, and amount at end of fortnight = $\frac{261}{260}$ of principal.
∴ principal or sum advanced = $\frac{260}{261}$ of £5 8s. 9d. = £5 8s. 9d. − $\frac{1}{261}$ of £5 8s. 9d. = £5 8s. 9d. − 5d. = £5 8s. 4d. Ans.

3. A cyclist travels for 4½ hours at a speed of 7 miles an hour, then for 2½ hours at 10 miles an hour, and finishes his ride at a speed of 12 miles an hour for 15 minutes. Find his average speed per hour.

Total number of miles travelled = 4½ × 7 + 2½ × 10 + ¼ × 12 = 31½ + 22½ + 3 = 57 miles.
Number of hours occupied = 4½ + 2½ + ¼ = 7 hours.
∴ Average speed = 57 ÷ 7 = 8⅛ miles per hour. Ans.

4. A, B and C can mow a field in five days. A and B can mow the same field in seven days. How long would it take C to mow a field twice the size?

Since A, B and C mow the field in five days, they mow ⅕ per day.
Since A and B mow the field in seven days, they mow ⅐ per day.
∴ C mows ⅕ − ⅐ that is $\frac{7-5}{35}$ or $\frac{2}{35}$ per day.
∴ Of a field twice the size C mows $\frac{1}{35}$ per day.
∴ The time in which C would mow the larger field = 35 days.
35 days. Ans.

BOYS AND GIRLS.

Grammar.

1. '*Thus*, *while* I *ape* the measure *wild*
Of tales *that* charmed me *as* a *child*,
Rude *though they be*, *still* with the chime
Return the *thoughts* of early time;
And feelings, *roused* in *life's first* day,
Glow in the line, and prompt the *lay*.'

Analyse this passage, and parse the words in italics.

A. Thus still with the chime return the thoughts of early time.
Principal clause.

B. While I ape the measure wild of tales
Subordinate clause, adverbial to A, denoting time.

C. That charmed me,
Subordinate clause, adjective to B, attributive to 'tales.'

D. As a child,
Subordinate clause, contracted, adverbial to C, denoting time.

E. Rude though they be,
Subordinate clause, adverbial to C, denoting concession.

F. And feelings, roused in life's first day, glow in the line,
Principal clause, co-ordinate to A.

G. And prompt the lay,
Principal clause, contracted, co-ordinate to A and F.

Connective	Subject with Enlargements	Predicate	Object with Enlargements	Extension of Predicate
A	The thoughts of early time	return		thus (*Manner*) still (*Time*) with the chime (*Time*)
B while	I	ape	the measure wild of tales	
C	that	charmed	me	
D as = when	[I	was] a child		
E though	they	be rude		
F and	feelings roused in life's first day	glow		in the line (*Place*)
G and	[feelings, etc.]	prompt	the lay	

Thus—adverb of manner, modifying verb 'return.'
while—conjunction, adverbial, introducing subordinate clause.
ape—verb, regular, transitive, indicative mood, present tense, 1st person, singular number, agreeing with subject 'I.'
wild—adjective of quality, positive degree, attributive to 'measure.'
that—pronoun, relative, 3rd person, plural number, neuter gender, agreeing with antecedent 'tales,' nominative case, subject to 'charmed.'

as—conjunction, adverbial, of time, introducing subordinate clause.
child—noun, common, singular number, common gender, nominative case, after intransitive verb 'was' understood.
though—conjunction, introducing subordinate sentence.
they—pronoun, personal, 3rd person, plural number, neuter gender, nominative case, subject of 'be.'
be—verb, irregular, intransitive, subjunctive mood, present tense, 3rd person, plural number, agreeing with subject 'they,' parts, *am*, *was*, *been*.
still—adverb of time, modifying verb 'return.'
Return—verb, regular, intransitive, indicative mood, present tense, 3rd person, plural number, agreeing with subject 'thoughts.'
thoughts—noun, common, plural number, neuter gender, nominative case, subject of 'return.'
roused—verb, regular, transitive, passive participle, attributive to 'feelings.'
life's—noun, common, singular number, neuter gender, possessive case, attributive to 'day.'
first—adjective of distinction, attributive to 'day,' ordinal numeral.
glow—verb, regular intransitive, indicative mood, present tense, 3rd person, plural number, agreeing with subject 'feelings.'
lay—noun, common, 3rd person, singular number, neuter gender, objective case, governed by transitive verb 'prompt.'

2. What English words are derived from the Latin verbs verto, I turn; video, I see; venio, I come; scribo, I write; rego, I rule?

English words derived from the Latin verb *verto*, I turn, are—avert, advert, convert, divert, invert, pervert, revert, controvert, verse, averse, adverse, converse, diverse, inverse, perverse, obverse, reverse, version, aversion, conversion, diversion, inversion, perversion, reversion, convertible, reversible, incontrovertible, diversity, perversity, controversy.

English words derived from *video*, I see, are—provide, evident, provident, improvident, evidence, providence, improvidence, evidential, providential, vision, provision, prevision, visionary, visible, invisible.

From *venio*, I come, we derive convene, intervene, advent, event, prevent, invent, invention, convention, intervention, prevention, convenient, inventive, preventive, preventible, convenience, inconvenient, inconvenience, venture, adventure, adventurous.

From *scribo*, I write, are derived—scribe, ascribe, describe, circumscribe, inscribe, prescribe, proscribe, subscribe, conscription, description, inscription, prescription, proscription, subscription, superscription, script, conscript, scripture, scrip, scribble, descriptive, indescribable, prescription, prescriptive, subscriber, manuscript.

From *rego*, I rule, are derived—regal, regent, regular, regulate, incorrigible, correct, direct, correction, direction, corrective, irregular.

3. 'Modern English is only a somewhat altered form of the language which was brought into England by the Saxons and Angles.'

Show that this is the case from what you know of the history of the language.

When the Angles and Saxons conquered Britain after the withdrawal of the Romans, they drove the former inhabitants to the extreme west, and made themselves entire masters of all the rest of the country. Such of the Britons as remained amongst the Saxons must have been in a state of servitude. Only a few British words remained in use, and these were simple geographical names, or names of common domestic utensils. Thus the language spoken in this country after the Saxon conquest was almost entirely that of the conquering tribes of Saxons and Angles.

The coming of the missionary band under Augustine resulted in the introduction of a few terms of Latin origin, referring for the most part to the services of the Christian religion. The inroads and temporary conquests made by the Danes introduced a few terms relating to sea-life, and modified some geographical names.

When the Normans came and made themselves in turn masters of the country, the ruling class retained their own language, and endeavoured to force its acceptance on the people they conquered. In this, however, they did not succeed, and though the pleadings in the courts were in Norman-French for some generations, this practice had at last to be abandoned, and the only permanent results of the attempts made to supersede the early English language, were the adoption of some Norman-French words relating to war, the court, the law, and the chase, and the modification of pronunciation and spelling of some of the older words.

The revival of classical learning in the 15th and 16th centuries caused many words of Latin and Greek origin to be adopted into the English vocabulary, and similar additions have been made as a result of the progress of science and invention, and the need for new terms to describe new objects. Still it remains true that the grammar of modern English is but a slightly modified form of what is called Anglo-Saxon, that our pronouns and connective words are almost identical with those used in the early stages of our language, and especially that the simplest and commonest words and phrases in everyday use are the same now as in early English.

Geography.

(Do *three* questions only.)

1. Say all you can about the following:—Alaska, Victoria, Don, Andorre, Boston, Novgorod, Oka, Galicia, Colon, Wellington, Fusiyama, St. Louis, Corea, Palmyra.

Alaska is a large territory of the United States occupying the extreme north-west of North America, and including the peninsula of Aliaska, the Aleutian Islands, and a strip of coast extending south to the Simpson River. It has an area of nearly 600,000 square miles. Its climate is very severe, and the soil barren, but the district abounds in fur-bearing animals. It formerly belonged to Russia. Its highest mountain is St. Elias, its longest river the Yukon, and its capital New Archangel.

Victoria is the name of several towns. One is the capital of British Columbia. It has a beautiful situation on the Strait of Juan de Fuca at the south-east of Vancouver's Island. It has one of the best harbours on the Pacific, and is used as a coaling station.

Victoria is also the name of a British Colony which occupies the south-eastern corner of Australia. It is about as large as Great Britain, and has a population of one million. It was founded in 1836, and is distinguished for its rapid progress, and for being the most prosperous and probably the wealthiest of our Australian colonies. Its north-western portion consists of plains to the south of the River Murray. Much of this forms fine pasture ground, and the land further south is suitable for agricultural purposes. A range of mountains runs through the centre, bearing the name of the Australian Alps in the east, and the Pyrenees and Grampians in the west. The capital is Melbourne, a remarkably flourishing city on the Yarra Yarra. The chief exports are wool, wheat, and gold. The gold fields were discovered in 1851, and have had much to do with the rapid progress of the colony.

Don is the name of a river in England which, after a course of about 55 miles in the south of Yorkshire, joins the Ouse at Goole. Another river of the same name runs through Aberdeenshire, and enters the North Sea close to Old Aberdeen.

Don is also the name of a large river which rises in the government of Tula, in Russia, flows for more than a thousand miles through a level district in the south of Russia, and then falls by several mouths into the Sea of Azov.

Andorre is the name of a small republic on the south side of the Pyrenees. The territory is about 36 miles long, and 30 broad. The population is about 12,000, and is under the protection of France and a Spanish bishop. The capital is a small town also called Andorre.

Boston is the principal city and sea-port of Massachusetts in the United States. It is beautifully situated on a peninsula in Massachusetts Bay. It has a very safe harbour, and carries on a large trade. It was the birthplace of Franklin, and is considered the literary capital of the States. Its population is over 360,000. The name commemorates the town of Boston, in Lincolnshire, from which some of its founders came.

Novgorod is a city of Russia, standing on the north of Lake Ilmen. It was once the most flourishing town of Northern Europe.

Oka is a river of Russia, which flows through several governments, and falls into the Volga at Nijni Novgorod, after a course of about 650 miles.

Galicia, the north-eastern province of Austria-Hungary, lies on the north slope of the Carpathians. It has an area of 20,000 square miles, and a population of nearly 6,000,000. Its agriculture, manufactures, and trade are all in a rather backward condition.

Galicia is also the name of an old province in the north-west of Spain.

Colon is a town of Colombia on the north side of the isthmus of Panama. It stands at one end of the Panama railway. It is known by the name of Aspinwall from the originator of the scheme for the Panama canal. It is a seaport, with about 12,000 inhabitants.

Wellington, besides being the name of two towns in England, one in Shropshire, and the other in Somersetshire, is the name of a provincial district of New Zealand, and of its capital. The district is the southern part of North Island. It is well-watered, well-wooded, and adapted for agriculture. The town has a population of over 20,000.

Fusiyama is a lofty conical mountain in the island of Niphon, Japan. It lies at a distance of 70 miles from Tokio, is 14,000 feet high, and is held sacred by the inhabitants. The name means rich scholar's peak.

St. Louis is the principal town of Missouri, United States. It stands on the Mississippi, a few miles below the point where the Missouri joins that stream. It has a university, is the centre of the fur trade, and the commercial capital of the Southern States. Its population is 350,000.

Corea is a peninsula on the eastern side of Asia. Its coast-line is elevated and its interior mountainous. The climate is severe, but much of the soil is fertile and well-cultivated. The people are exclusive, but acknowledge a partial subjection to the Chinese. They trade with China and Japan. The area is about equal to that of Great Britain, and the population about 7,000,000.

Palmyra is a ruined city of Turkey in Asia, situated on an oasis in the desert of Syria. The remains, which occupy about three square miles, give evidence of former wealth and splendour. It was the city called Tadmor in the Bible.

2. Give a short description of the most important country or State in each of the four continents.

Germany is the country which during the past few years has become the most important in Europe in several respects. It occupies a central position, extending from the southern shore of the Baltic Sea to the Alps, and from the borders of Holland, Belgium, and France on the west, to Russia and Austria on the east. It consists of a large number of States having some kings, some princes and some dukes as local rulers, but all being subject to the Emperor as ruler of the German Empire. The total area is 208,000 square miles, and the population 46 millions. The chief States are Prussia, Saxony, Wurtemburg, Bavaria, Hanover, and Baden. The coast line is not extensive, and owing to the blocking of the Baltic Sea in the winter, the ports are not always accessible. This cripples the maritime trade and naval power of the Empire. The surface is mountainous in the south towards the boundaries of Switzerland and Austria, but most of the country forms part of the great central plain of Europe. The chief mountains are the Black Forest range, the Hartz Mountains, and the Erz-Gebirge. The most important rivers are the Rhine, the Danube, the Elbe, the Oder, the Vistula, and the Weser. The largest towns are Berlin, Hamburg, Dresden, Munich, Stuttgardt, Frankfort-on-the-Maine, Cologne, Bonn, Elberfeld, Magdeburg, Chemnitz. The success of the efforts to secure the unity of Germany, and the consequent advance of the country in political influence have been very remarkable.

Hindostan may fairly be regarded as the most important country in Asia. It consists of a large triangular peninsula extending into the Indian Ocean, with a large mass of land to the north, occupying the southern slopes of the Himalaya mountains, and the plains enclosed by that great range and the Hindoo Koosh and Suliman mountains. The length of Hindostan from north to south is 1,850 miles, and its area is about 1½ million square miles. Beside the Himalaya range, which is the greatest mountain mass, and which contains many of the highest peaks in the world, some almost 30,000 feet high, there are the Aravulli mountains, partly separating the two great plains of the north, and the Vindhya mountains stretching to the north of the Deccan, an elevated plateau which occupies the centre of the southern half of the country. On the east and west of the Deccan, at no great distance from the coast, extend the two ranges called the Eastern and Western Ghauts. The great plains of the north are watered by the rivers Ganges and Indus, and their tributaries, the plain of the Ganges being a remarkably fertile district, while that of the Indus is to a large extent a sandy desert. The rivers which drain the southern half of India are the Taptee and Nerbudda on the west side, and the Mahanuddy, Godavery, Kistna and Cauvery on the east. A great part of the country is within the tropics, and, except during three months of the year, the climate is very hot, and almost intolerable for Europeans. During the hot season European residents betake themselves to the cooler places among the hills. Hindostan produces cotton, indigo, opium, wheat, rice, tea, coffee, and fruits in great abundance; and its mineral wealth includes precious stones, gold, silver, iron, coal and salt. The country is divided into a large number of States, some of which are ruled by independent, or semi-independent native chiefs, but most of the Hindoos are subject to the British Government. Our dominions in India, having a population of about 200 millions, are divided into the three Presidencies of Bombay, Madras, and Bengal, each under a governor, with groups of provinces under lieutenant-governors, and with a governor-general over all, representing the Queen, or, as she is called, the Empress of India. The capital of Hindostan is Calcutta, on the Hooghly, one of the mouths of the Ganges. It has about 900,000 inhabitants. The other chief towns are Bombay on a small island on the west coast, Madras on the east coast, Delhi, Lucknow, Agra, and Patna in the basin of the Ganges, and many others on the coast and on the banks of the great rivers.

Egypt, from its historical and political interest, may be called the most important country of Africa. It occupies the north-eastern corner of the Continent, having the Mediterranean Sea on the north, the Red Sea on the east, Nubia on the south, and the African desert on the west. Its area is about 400,000 square miles, but only a very small portion of this is fertile. Most of the surface forms a barren sandy desert, the chief exception being the narrow valley of the Nile, which owes its extreme fertility to the annual overflow of the famous river. The Nile enters the country from the south, and brings down from the lofty mountains near the equator an enormous quantity of water, especially after the melting of the snow. It is a remarkable fact that this river, the total length being 4,100 miles, receives no tributary for the last 1,700 miles of its course. It enters the sea by several channels, and forms a large delta, which constitutes the other fertile part of Egypt. The chief objects of cultivation are cotton, sugar, wheat, rice, tobacco, and hemp. The principal towns are Cairo, the capital, at the apex of the Nile delta; Alexandria, Rosetta and Damietta on or near mouths of the Nile; Port Said, Ismailia, and Suez on the line of the famous canal which connects the Mediterranean and Red Seas, and forms such an important link in the communication between the west of Europe and Hindostan. Egypt is under the suzerainty of Turkey, but its subjection at present is not much more than nominal. For some time past the country has been occupied by British troops. Among the relics of Egypt's ancient greatness should be mentioned the Pyramids, the Sphinx, the ruins of its temples, and the great monoliths, one of which has been brought over and erected on the Thames Embankment.

The United States form a great country which stretches across North America from the Atlantic Ocean to the Pacific, and has an area equal to that of Europe. Its boundary on the north passes through the great lakes, and along the 49th parallel of north latitude, while on the south it is bounded by Mexico and the Gulf of Mexico. The Rocky Mountains, which in some places reach a height of 14,000 feet, run through the western portion of the States from north to south. In the eastern States is an inferior range called the Alleghany Mountains. Besides the southern part of all the great lakes of the St. Lawrence chain, the whole of Lake Michigan belongs to the United States, as also the Great Salt Lake in the Utah territory. The greatest river is the Mississippi, which is about 4,000 miles long, and with its giant tributaries the Missouri, Arkansas, the Red River, and the Ohio drains the great plain which occupies the centre and south of the country. The most important river in the east is the Hudson, a comparatively small one; in the west are the Columbia, the Sacramento, and the Colorado. Being well-watered and in a temperate region of the globe, the United States are remarkable for the fertility of the soil and the wonderful adaptation to agricultural purposes. With slight trouble vast crops of maize, wheat and other cereals are grown in the north, and cotton, rice, sugar, and tobacco in the south. The mineral wealth is also very great, and includes gold, silver, iron, coal and copper. The fisheries of cod, herring, lobster, and salmon are very productive; and the manufactures of cotton and woollen goods, tools and machinery form an extensive and growing class of industrial pursuits. The country is a Republic, and consists of 38 States and 10 territories; and the population, which has increased very rapidly, is over 40 millions. The capital is New York, at the mouth of the Hudson. Among other large towns are Philadelphia, Boston, Chicago, Pittsburg, Washington, New Orleans, St. Louis, and San Francisco.

3. Give as full an account as possible of the motion, the composition, and the influence upon our earth of the moon. Describe also any other satellites attendant upon any of the planets.

The moon revolves round the earth at a mean distance of nearly 239,000 miles in rather more than 29 days. The orbit of the moon is inclined at a very small angle to the orbit of the earth. The moon rotates on its own axis in exactly the same time as it takes to complete a revolution, and hence the same part of its surface is always turned towards the earth. The different appearances of the moon at different times, or its *phases*, are thus explained: the moon shines by the sun's light reflected from its surface. When in its revolution round the earth the moon comes between the earth and the sun, the sun's light falls on the surface turned away from us. This is called the time of *new moon*, and the moon is practically invisible. As it goes on in its course, a portion of the surface turned towards the earth becomes illuminated, and the moon appears as a *crescent*. About seven days after new moon half the surface is visible, and this is called *first quarter*. The illuminated portion goes on increasing, and passing through the appearance called *gibbous* at length the whole of the surface turned towards us is visible about 14 days after new moon, that is at *full moon*. Similar changes take place in reverse order till the time of new moon comes round again.

The observation of astronomers has proved that the moon is a globe having a diameter of about 2,160 miles. Its volume is rather more than $\frac{1}{50}$ of that of the earth, but owing to its being of less density its mass is less than $\frac{1}{80}$ of the earth's mass. The surface is varied with mountain ranges and peaks, plains, and what appear through a powerful telescope to be great clefts or cañons. There is reason for believing the moon to have been the scene of violent volcanic action, which has resulted in making it like the corpse of a world with no life, no vegetation, no water, no air.

The chief influence the moon has upon the earth, besides giving the mild reflected light which brightens our nights, is evident in the tides. Owing to the comparative nearness of the moon, its attractive energy is very potent. Acting with greater force on the waters of the earth nearest itself, the moon raises them into a broad wave which moves as the earth rotates. A similar wave is produced on the opposite portion of the earth's surface by the solid body of the earth being drawn with greater force than the water at a greater distance from the centre of the attraction. These waves are called tides, and are highest at the times of new and full moon, when the attractive force of the sun acts in the same direction as that of the moon, and lowest at first and third quarter, when the sun's influence partly neutralises the moon's.

The moon's attraction must act similarly on the atmosphere and produce atmospheric tides; and a theory has been projected which meets with considerable acceptance that the moon has some effect in producing earthquakes and volcanic disturbance. It is an old doctrine that the moon influences the weather, and this is perhaps true in the sense that the moon's action on the water surface and on the air is likely to have effects upon conditions affecting the weather. It ought to be mentioned that about the time of new moon a faint light called earth-shine is observable on the face of the moon, and is caused by the second reflection from the moon of light reflected upon it by the earth.

When the centres of sun, earth, and moon are exactly in a right line an eclipse is caused. If the moon comes exactly between the sun and the earth, the sun's light is interrupted, and an eclipse of the sun occurs. If the earth is exactly between the sun and the moon, the latter body is in the earth's shadow, and the eclipse is a lunar. There would be two eclipses every month if the moon's orbit were not inclined to the earth's.

Besides the moon, which moves round the earth, as many as 19 other satellites have been discovered revolving round the primary members of the solar system. Mars has two, Jupiter four, Saturn eight, Uranus four, and Neptune one. In every case the time of rotation is exactly equal to that of revolution, and the direction in which they rotate is the same as in the case of the primaries, namely, from west to east. The direction of revolution is also the same, except with the satellites of Uranus, which move from east to west. The density of Jupiter's moons has been discovered to be rather greater than that of Jupiter. Observation of the eclipses of the satellites, whose times of revolution have been determined, and whose positions at specified times can therefore be calculated, is made use of to determine longitude.

4. Draw a map of France, China, or the United States.

Two hours and a half allowed.

GIRLS ONLY.

Needlework.

(One hour allowed for this Exercise.)

Join two pieces of calico, 7 inches long, by a sew and fell seam. Along one of the joined ends fold a hem 1 inch wide, on which work a button-hole. Above the hem fix two tucks, $\frac{1}{4}$ of an inch wide.

BOYS ONLY.

Arithmetic.

(Four questions only to be attempted.)

1. (*a*) What are the relative advantages of vulgar and decimal fractions? In what cases are vulgar fractions convertible into terminating decimals? Why will $\frac{1}{25}$ give a terminating decimal, while $\frac{1}{75}$ will not? (*b*) Express as a vulgar fraction the value of each significant figure in ·003077.

(*a*) Vulgar fractions have an advantage over decimal fractions in the fact that by them a fractional value may often be exactly expressed with a small number of figures easily remembered and comprehended, while the decimal form of expression would not only require more figures, but would then only express the value approximately. Another advantage of vulgar fractions is that the operations of addition, subtraction, multiplication, and division, can be performed so as to secure results exactly correct. In some cases this cannot conveniently be done by using decimal fractions, for example when a multiplier or divisor is non-terminating.

Decimal fractions have advantages arising from the value of figures being determined by their position as in the case of whole numbers expressed on the decimal system.

The ordinary processes of arithmetic can be applied to fractions which terminate in the decimal form just as they can to whole numbers; and in those which do not terminate a result can often be speedily arrived at which shall be correct to any desired degree of approximation.

Vulgar fractions which are convertible into terminating decimals, are those which when reduced to their lowest terms have no other prime factors in their denominators than 2 and 5.

Thus $\frac{1}{25}$ is a vulgar fraction which can be expressed as a terminating decimal, for its denominator is equal to 5×5, and if numerator and denominator be multiplied by 2×2, or 4, we have $\frac{4}{100} = \cdot 04$.

But $\frac{1}{75}$ cannot be converted into a terminating decimal for its denominator equals $5 \times 5 \times 3$ and no multiple of this will be equal to a power of 10.

(*b*) In the decimal ·003077, 3 stands for $\frac{3}{1000}$, 7 for $\frac{7}{100000}$, and 7 for $\frac{7}{1000000}$.

2. How much stock must a man have in the Three per Cents. so that he may receive a net dividend of £348 after an income tax at 8d. per £ is deducted?

Each £100 of stock will produce £3 gross income.
The income tax on £3 at 8d. in the £1 = 2s.
∴ the net income from £100 of stock = £3 − 2s. = £2 18s.
∴ the stock required to produce £348 net income

$$= \frac{£348}{58s.} \times 100$$

$$= \frac{348 \times 10 \times 100}{29} = \underline{£12{,}000.} \text{ Ans.}$$

3. If by selling a horse for £51 15s. a dealer gains $12\frac{1}{2}$ per cent., at what price ought he to sell it to gain 25 per cent.?

$12\frac{1}{2}$ per cent. = $\frac{1}{8}$ of cost price
= $\frac{1}{9}$ of selling price in 1st case
= £51 15s. ÷ 9 = £5 15s.
25 per cent. = double $12\frac{1}{2}$ per cent.
∴ selling price to gain 25 per cent. = £51 15s. + £5 15s.
= £57 10s. Ans.

4. Find the cost of 375·4875 acres at £2 13s. 9d. per acre.

£375·4875 = cost at £1 per acre
= £375 9 9 = ,, ,, ,,
Of £1, 10s. = $\frac{1}{2}$ 2
750 19 6 = ,, £2 ,,
Of 10s., 2s. 6d. = $\frac{1}{4}$ 187 14 $10\frac{1}{2}$ = ,, 10s. ,,
Of 2s. 6d., 1s. 3d. = $\frac{1}{8}$ 46 18 $8\frac{1}{8}$ = ,, 2s. 6d. ,,
23 9 $4\frac{5}{16}$ = ,, 1s. 3d. ,,
£1,009 2 $5\frac{13}{16}$ = ,, £2 13s. 9d. per acre

£1,009 2s. $5\frac{13}{16}$d. Ans.

5. What will be the expense of carpeting a room 24 ft. 6 in. long, 18 ft. wide with carpet 27 inches wide, at 5s. 6d. a yard?
No. of breadths = 18 ft. ÷ 27 in. = 18 ÷ 2¼ = 72 ÷ 9 = 8
∴ Length of carpet required = 24 ft. 6 in. × 8 = 196 ft.
= 65⅓ yds.
∴ Cost of carpeting = 5s. 6d. × 65⅓ = £17 17s. 6d. + 1s. 10d.
= £17 19s. 4d. Ans.

History.

BOYS AND GIRLS.

(N.B.—Answer *three* of these questions, either the first or the fourth being one.)

1. When was the Feudal System brought into England, and when did it die out? What benefits, if any, attended its introduction and extinction?

Traces of certain elements of a feudal character may be found in the system of land tenure which prevailed among the Saxons in England before the Norman Conquest; but what is properly understood as the Feudal System was introduced by William of Normandy, as one chief result of the Conquest of 1066. This system, with its fundamental ideas that all the land of the country belonged to the king, and that those who held the estates were bound to render military service to the king, was calculated to strengthen the position of the sovereign, by providing him with the means of raising an army with little trouble. But in course of time a different result was practically brought about. By the practice of subinfeudation the knights who held land from the king gathered about them sub-tenants, holding on similar conditions of military service, and so formed bands of retainers at the command of their immediate lords. Thus the power of the barons grew up and became a check upon that of the crown, especially when the latter was in the hands of weak monarchs like John and Henry III. The immediate benefit derived by the people from the introduction of the feudal system lay in the personal protection which the king, and under him the knights, were bound to render to their retainers.

After a time it became common for fines to be paid in lieu of rendering military service, and the feudal system was gradually undermined. During the Wars of the Roses the nobles were reduced in numbers, in wealth, and influence, and feudalism in its essential features was destroyed. It was not, however, till 1660 that the military tenure and other incidents of the system were abolished by law, an Act with that object being passed by the parliament which confirmed the restoration of Charles II. The special benefit of this Act was to limit the power of the sovereign and protect the landed gentry against unreasonable exactions. The earlier practical abolition of feudalism, brought about by the long-continued Wars of the Roses, had for its first effect the substitution of almost absolute monarchical power for the power the barons had exercised over the people; but a further result of the change was the development of a powerful middle class and the growth of a free peasantry, in place of the villeins and retainers of feudal times.

2. What was the aim of the Exclusion Bill of 1679? How was it defeated?

The Exclusion Bill of 1679 originated in the popular dread of a Roman Catholic successor to Charles II., and the general dislike felt by the people towards James, Duke of York, the king's brother, and heir presumptive to the throne. The object of the Bill was to exclude James from the succession. The House of Commons having passed it in 1679 by a considerable majority, Charles, who strongly opposed the measure, dissolved the parliament. In the following year a new parliament was summoned, and after a long prorogation the Commons again passed the Bill. But when it came before the Lords, Charles himself attended the House throughout the debate, and used his personal influence to back up the eloquence of Lord Halifax, the only prominent member of the country party who was opposed to the Bill. The result was its rejection by the peers.

3. What produced war between England and America in 1812? How did the war end?

In 1806 Napoleon issued an order called the Berlin Decree which forbade all intercourse with England, and all use of her manufactures or colonial products. Soon after orders in council were adopted by the English in a spirit of retaliation. These declared the whole French coast in a state of blockade, and claimed the right of search for French goods on vessels belonging to neutral Powers. This claim was the cause of quarrel between America and England, which did not however reach the stage of open hostility till 1812. In 1811 Napoleon removed the restrictions on trade from American vessels, and then as the English did not follow his example the Americans passed a non-intercourse Act, to take effect if the obnoxious orders were not recalled. This was done after some months, but the concession came too late, for the Americans had declared war a few days before. In the course of the war naval engagements were lost first by the English and afterwards by the Americans. The latter made unsuccessful attacks upon Canada, but the English also experienced serious reverses, especially in an attack they made upon New Orleans. On the abdication of Napoleon in 1814, the Americans became inclined for peace, and a treaty was signed at Ghent, by which a mutual restoration of conquests was agreed upon, and the settlement of the border line was left in the hands of commissioners of both nations.

4. Name four of our leading statesmen since the beginning of the nineteenth century, and briefly describe the policy pursued by each of them.

Among the many eminent statesmen who have held the highest political office in this country during the present century these four may be mentioned as conspicuous—George Canning, Sir Robert Peel, Viscount Palmerston, and Mr. William Ewart Gladstone.

Canning was a man of remarkable earnestness and ability, but he held the office of Prime Minister for a short time only, in the year 1827, when he succeeded Lord Liverpool. Though he belonged to the Tory Party his large-hearted sympathy with the oppressed in any part of the world, his efforts to extend liberty to the slave, and to remove the political disabilities of the Roman Catholics, mark him as a fore-runner of the modern Liberals. He was also in favour of a reform of the burdensome Corn Laws. His death so soon after attaining the Premiership prevented his seeing the fruit of his earnest endeavours, and was a great loss to the country.

Sir Robert Peel was a member of the Conservative Party; but becoming convinced of the evils connected with 'Protection,' he boldly adopted a policy of Free Trade, and in 1846 carried the measure for abolishing the Corn Laws in opposition to the mass of his Party. Before this his name was associated with the Catholic Emancipation Act, and with the opposition to the Reform measures of Earl Grey and Lord John Russell.

Lord Palmerston began his political life as a Tory. He afterwards joined the Free Trade Party of Sir Robert Peel. His fame rests chiefly on his conduct as Foreign Minister. His policy was to maintain at all costs British honour and prestige. He was a thorough Englishman, and he was proud to adapt as applicable to the Briton, the boast of the Roman, *Civis Romanus sum*. He was honoured by Liberals and Conservatives alike, for he was pleased to avoid organic reform, and yet he was always on the side of steady progress. He died in 1865.

Mr. Gladstone's career has probably been more remarkable than that of any other statesman of this century. Like others already named he began as a Tory, and afterwards found his way, with Peel, to Liberalism. He assisted in the Free Trade movement, and as Chancellor of the Exchequer under Lord Palmerston and Lord John Russell extended that movement with wonderful skill and success by abolishing the Customs duties on a host of articles imported from foreign countries. By his efforts the paper duty was abolished, and other restrictions on the spread of knowledge have been removed. As Prime Minister he has promoted and passed several measures for the improvement of our relations with Ireland, others for extending the parliamentary franchise, and re-arranging the boundaries of borough and county divisions. He appears to have adopted for the basis of his policy Freedom, Justice, and Trust in the People. His latest great attempt at legislation was to satisfy the aspirations of the people of Ireland for Home Rule; but in this he has so far failed, as public opinion appears not yet ripe for such a change.

Teaching.

FOR TEACHERS IN SCHOOLS FOR OLDER CHILDREN.

1. Write notes of a lesson on the predicate of a sentence.

First Step.—Draw from the children some examples of the simplest form of sentence. Write these on the Blackboard, as, Fire burns, Boys play, Lions roar, The swallow flies, etc.

Deduce from a comparison of these sentences that each consists of two parts, one of which stands for that about which we make a statement, the other for what we state respecting it.

These two parts are called respectively the *Subject* and *Predicate* of the sentence.

Second Step.—Definition,—The predicate is that part of every sentence which makes a statement or assertion about the subject. This definition should be elicited from the children by simple and careful leading questions on the sentences used in the First Step. Then it should be noted that in every instance given the predicate is a *verb*; and it should be deduced that every sentence must contain a verb. At this point introduce a short exercise by requiring children to supply single-word predicates to given subjects. Birds——, The sun——, Fishes——.

Third Step.—Take some examples of more extended sentences using compound forms of the verb; thus—Henry has arrived. Truth shall prevail. Carthage must be destroyed. Take also some in which a verb is used with an adjective to tell something of the subject, as, The storm was destructive. The child is cold. The scenery is beautiful. Let all these examples be divided into the two essential parts of the sentence, and lead the children to understand that in every case the compound verb or the verb and adjective fit the definition given. Further variations in the form and length of sentences should be illustrated.

Fourth Step.—Completion of Predicate. Give a few examples of such verbs as divide. The father divides——. The fire roasted——. The horse bore——. Deduce that these are incomplete statements. They require something named after the verb, as the oranges, the meat, his rider. Such verbs are called Transitive Verbs; the words added to complete the statement form the object. Require some other examples to be supplied. Show that all the words after the subject make up the complete predicate.

Fifth Step.—Extension of Predicate.—Give some examples to show that other words may be added to the verb, not as necessary to complete the statement, but to extend its meaning, or make it fuller. Thus, The water flows—smoothly. The branch fell—to the ground. The temple was rent—in twain. These extra words or phrases are called Extensions of the Predicate. Taken together with the verb they form the whole predicate.

Further exercises should be given in a succeeding lesson to illustrate the inversion of a sentence—with the predicate first, as,—

Flashed all their sabres bare.
Great is Diana of the Ephesians.
Smack went the whip.

2. Give examples of some arithmetical questions worked mentally, preparatory to a first lesson on addition of fractions.

Add $\frac{1}{2}$ and $\frac{1}{4} = \frac{3}{4}$. $\frac{1}{2}$ and $\frac{1}{3} = \frac{5}{6}$.

How do you add a halfpenny and a farthing?

The halfpenny is two farthings, and added to one, the result is three farthings. The same question in another form, $\frac{1}{2} + \frac{1}{4}$.

How do you add 3 florins to 2 crowns? Reduce both to shillings. 3 florins = 6s. 2 crowns = 10s. Sum = 16s.

What do we do to quantities expressed in different denominations before adding them? Bring them to the same denomination.

What is the least common multiple of 2, 3, 4? 2 is contained in 4, and may therefore be neglected. L.C.M. $= 3 \times 4 = 12$.

L.C.M. of 8, 6, 9? 2 is contained in 8 and in 6, 3 is contained in 6 and in 9. Dividing the product $8 \times 6 \times 9$ by 2×3, we have $8 \times 9 = 72$ = L.C.M.

Add, $\frac{1}{2}$ and $\frac{1}{3}$. $\frac{1}{2} = \frac{3}{6}$, $\frac{1}{3} = \frac{2}{6}$, sum $= \frac{5}{6}$.

Add, $\frac{3}{4}$ and $\frac{1}{3}$. $\frac{9}{12} + \frac{4}{12} = \frac{13}{12}$.

Add, $\frac{1}{4}$ of £1 and $\frac{1}{5}$ of £1, 5s. + 4s. = 9s. or $\frac{5}{20} + \frac{4}{20} = \frac{9}{20}$.

3. What is essential to the full drawing of a map?

To draw a map fully observe the following rules:—

(*a*) Carefully reckon the proportionate length and breadth necessary for the enclosing frame.

(*b*) Insert the lines of latitude and longitude with the proper numbers in the margin to indicate the degrees.

(*c*) Draw the coast with a clear bold outline; and the frontier with a dotted line.

(*d*) Place thick firm lines to represent the mountain ranges.

(*e*) Draw the rivers with wavy lines slightly increasing in thickness from the source to the mouth. Draw similarly the chief tributaries.

(*f*) Make the lakes, if any, with a clear outline, like the coast.

(*g*) Mark the towns with round dots, except capital cities, which should be square.

(*h*) Use plain italic letters, as a rule, for the names of places. For rivers and mountains the names should run alongside the representing lines; for lakes and islands write the names in or near the space occupied; for capes and towns put the names if possible with the first letter close to the spot indicated; for countries, divisions of countries, oceans, and parts of the sea use block letters.

For Teachers in Infant Schools.

1. Write notes of a lesson on some article of manufacture.

A China Tea-Cup.

Class of children, 7 years of age.

Apparatus required.—Blackboard, picture of potter's wheel, specimen tea-cup, and if possible some china-clay and flint.

(1.) *Introduction.*—Show *tea-cup*, and from observation of children deduce that it is *brittle*, and that it could not be moulded into shape while in a brittle state. It must have been shaped when it had quite different qualities. What material was it originally? Answer: clay. Show clay and contrast its *plastic* or easily-shaped substance with the brittle or easily-broken china.

(2.) *Materials used.*—Cornish clay, bones, ground flints. The clay is made into a paste by moistening it. The flints are made red-hot, and then crushed. The bones also are burnt or *calcined*.

(3.) *Preparation.*—These materials are put into a vessel of water and stirred till mixture is almost like milk. In this form it could not be moulded; so it is boiled until much of the water has boiled away (evaporated). When the paste is firm enough it is divided into lumps, and these are slapped to drive out all the air.

(4.) *How the cup is made.*—When the clay is quite prepared, a lump is taken and placed on a plate or disc in front of the *potter*. By means of a wheel or lathe, which may be worked by the foot, the disc with the clay on it is made to go round as fast as the workman wishes, and as it does so, he moulds it into a hollow vessel with his thumb and fingers, which he now and then dips into water, to keep the clay moist enough. This process requires great care and skill. It is called *Throwing*. Explain it by reference to the picture of the Potter's Wheel. The handle is moulded separately, and then fastened on.

(5.) *Drying and hardening.*—When the cup is shaped it is put, with many others, in a hot room to dry. Then it is enclosed in a coarse earthenware vessel, called a *sagger*, and a number of saggers are packed in a *kiln* or furnace, where the china is fired for forty hours or more. The furnace is allowed to cool gradually, and the tea-cup is in this state called *biscuit*. Though firm, it is *porous*, and water would get through it.

(6.) *Glazing.*—To make cup of use for holding water or tea, it is dipped into a milky looking mixture formed by melting together granite, white-lead, and broken glass. Then it is fired again for a shorter time, and after this it comes out of the furnace smooth and shiny, having a coating of glass. This process is called glazing.

(7.) *Colouring and gilding.*—After this coloured patterns may be made on the cup by hand-painting, the paint used being of a peculiar kind, in many cases of the nature of liquid glass. Gilding is done by laying on a preparation of gold like paint. After painting and gilding, the china is again fired to fix the colours.

Some coloured designs are put on the biscuit by a printing process like that used in children's transfer papers. The pattern is printed on prepared paper. This is laid on the biscuit, which absorbs the colours. The paper is washed off, and the pattern remains. The glazing and firing follows.

2. How would you give a first lesson on 'carrying' in subtraction? Ex. 47 — 26.

(1.) Show that in taking 26 from 47 we can take the 6 units from the 7 units, leaving 1, and we can take the 2 tens from 4 tens, leaving 2 tens. The answer is thus 21. Work a few other examples of the same kind.

(2.) Now, let us change the place of the figures, and putting 74 instead of 47, take 26 from it. Here we find we cannot take the 6 units from the 4 units. Why? 6 is more than 4. What can we do? We know that 26 is *less* than 74, so we *can* take 26 from 74.

(3.) Here we would take some easy examples to illustrate the principle that if we have two numbers of anything the difference between them will not be altered if we add equal numbers to each of them. 26 is less than 47 by 21, so 28 is less than 49 by 21, and also 36 is less than 57 by the same number. If a boy is 5 years older than his sister now, he will always be 5 years older as long as they live, though each grows at the same rate as the other.

(4.) Now, let us apply this to the question. To the 4 add 10, and make it 14; then we can take away the 6 and leave 8. To balance the addition of 10 to the units in the first number 74, we must add 10 to the second number 26. This we can do by calling the 2 which stands for 2 tens, 3 that is 3 tens. Taking 3 tens from 7 tens we have 4 tens left. So our complete answer is 48. We can show it to be right by adding it to 26, and we make the sum 74 again.

Hence we can make a rule, if in a subtraction sum we find the unit figure is larger than the one from which it is to be taken, we add 10 to the latter number and then subtract and set down the remainder. Next proceeding to the tens we add 1 to the number of tens to be taken away, and put down the number of tens left after subtracting. The adding 1 to the tens is often called '*carrying*.' The misleading words 'borrowing' and 'paying back' should be carefully avoided.

The rule should be exemplified by many short and easy examples before extending it to hundreds. The main point is to impress the principle that equal additions do not alter the difference.

3. Which of the following words present difficulties in spelling —suit, their, full, bear, tear?

In each of these words there is some difficulty—that is, some danger of misspelling from confusion or false analogy, but the difficulty is different in degree.

Suit resembles only one common word of similar sound—*fruit*. The *i* is silent; *u* when long is oftener followed by *e*.

Their with beginners is commonly confounded with *there*. The distinction, being a grammatical one, presents much difficulty to young children, who cannot well understand the explanations addressed to them from their necessary ignorance of grammar.

Full has no great difficulty for children. When they begin to have such words as wilful and fulfil, they may need warning against using one *l* in the monosyllable, but they are likelier to double it where it should be single.

Bear may be misspelt *bare*, especially as there are two uses of the word *bear*, and two also of the word *bare*, and all are sounded exactly alike.

Tear is not likely to be found difficult when used as a noun with the long *e* sound like *dear*, but as a verb it is very likely to be spelt *tare*.

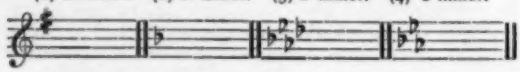
Music.

(*A quarter of an hour allowed for this Paper.*)

N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*.

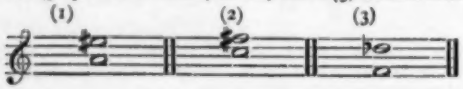
STAFF NOTATION.

1. Write the signatures of the following *minor* keys:
(1) E minor. (2) D minor. (3) F minor. (4) C minor.

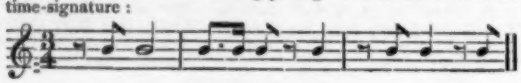


2. Write above (1) an augmented fifth, above (2) an augmented (pluperfect or tritone) fourth, above (3) a minor sixth.

(1) (2) (3)



3. Add bars to the following passage in accordance with the time-signature:



TONIC SOL-FA NOTATION.

1. Write (1) above *ray* an augmented fifth, (2) above *doh* an augmented (pluperfect or tritone) fourth, and (3) above *fah* a minor sixth.

(1) *le* *ray* (2) *fe* *doh* (3) *ra'* *fah*.

2. What is the name (1) of *ray* sharp, (2) of *me* flat, (3) of *doh* sharp?

(1) *re*. (2) *ma*. (3) *de*.

3. Re-write the following, doubling the value of every note and rest. Use four-pulse measure.

s ,f .m : .r	m . ,f	s : ||
s .f :m | :r	m :- .f	s : ||

ADDENDA.

On page 496 of our last issue the mariner's compass is mentioned as required to determine the direction in which the observer looks at the sun. Though the compass is used in guiding the ship's course, the instrument by means of which the exact time when the sun crosses the meridian is conveniently and accurately determined, is that named further on in the answer, viz., the *sextant*.

In the last paragraph 'declination' of the sun occurs in two places for 'altitude.' It may be well here to re-state the method by which latitude is ascertained. The sailor by means of the sextant determines the altitude of the sun, or the number of degrees he is above the horizon when he crosses the meridian. Taking this from 90° he finds the zenith distance or number of degrees the sun is from the zenith. Better still, the zenith distance might be directly observed. Then turning to the proper date in the nautical almanac the sailor would find the declination of the sun, that is the number of degrees the sun is north or south of the celestial equator. The declination, according as it is north or south (*vice versa* in south latitude) is then added to, or subtracted from, the zenith distance, and the result is the latitude sought. When the pole star can be observed its altitude gives the latitude at once.

—o—

The Näs Slöjd.

BY MISS J. WARREN,

Inspectress of Infant Schools to the Leicester Board.

Of the six or seven articles in our course which I shall describe this month only two are peculiar to Swedish industry or custom, namely, the *bread fan* and the *shuttle*.

The bread fan is the *twenty-sixth model*, and following as it did the making of a scoup afforded variety and contrast.

This peculiar article is about a foot in diameter, and, save for the projection of a small handle, perfectly round. It is used in the manufacture of bread. It resembles the palm fan of the present day in appearance. At its thickest edge it is about half an inch and tapers off to about one-sixteenth of an inch. One operation in its make deserves special notice—three pieces of wood (plank form) had to be glued together before the article is really begun; this work was entirely new to us; its excellence depends upon one or two points—in the first place the edges must be planed to a nicety their whole length; no easy task for beginners. Then the glue must be thoroughly good and of a suitable consistency. When these details had been properly attended to we next

secured the whole affair by means of our oaken screw, leaving it one whole night to become fixed. I have learned just recently how very much loss and inconvenience may accrue from such an operation being indifferently done, for an oak tea-tray I have been carving is, in my opinion, completely spoilt by the work of the cabinet maker; the pieces not only parted and showed the fixing, but had to be repaired by the insertion of wedges.

The rules I have fully quoted in former papers will convince my readers of the wisdom of the prohibition of works of luxury. Had I adhered closely to my Slöjd teaching I should have fixed this wood myself, and so worked on a safe foundation; as it is I derive some little satisfaction in finding that my own work is far better by actual comparison than that of a professedly skilled cabinet maker's workman.

After the fixing of these pieces of wood was finished a shaft had to be inserted right through the thing in a groove made with a chisel. This was to secure it from warping either with fire or water. The surface is planed and made gradually thinner directly opposite the handle. The edge is bevelled. I have shown mine to a great many people, and no one discovers that it is made of more than one piece of wood.

The bread fan is in common use in every cottage in Sweden; it therefore is a very good article for an elementary Slöjd course.

The twenty-seventh model is a shuttle; this most intricate and beautiful little model afforded us full scope for good work; it is only with great care and very high finish it can be made to answer its purpose. For it we selected a piece of strong, well-seasoned wood about twelve by six inches. Here again we use the Slöjd knife very largely, the thing has so many turns and curves as to require hand manipulation—an entire change from the work immediately preceding it. When one considers the thousands of times this shuttle passes through the hands of the housewife as she makes the articles for her children's and husband's use—winter after winter—it will be seen how smooth and thorough it must be made to do its work at all.

I am afraid that no substitute could be found in an English Slöjd for this useful article—the nearest to it would be a toy-boat.

The twenty-eighth model is a boot-jack. I do not find that all town bred folk know what a boot-jack is, but I refrain from describing it, as I feel sure no teacher is without the knowledge.

I have no new operation to record in this work, the foot was simply a piece inserted in a very strong chiselled groove. A V-shaped cut served for the shoe, the wood was of a light kind, and the principal work done with the large plane. It was completed by us in a day. It was evidently intended as a stepping-stone to the one I speak of farther down in this same paper.

The twenty-ninth model is a strong box. I call it this for want of a better name. This was the first box in our course, and we began the work with much satisfaction, for who cannot realise the delight of feeling that with your own hands you fashion something that is useful.

The box was about sixteen inches long and five broad; with no lid; the pieces were dove-tailed together, and in the centre was an inner division. I have seen just such a box in use in the London Board Schools for the beads and sticks used in the Kindergarten.

I think were I obliged to take one of the many means at hand for *joining* in a school manual course I should certainly choose dove-tailing. It can be used for almost anything, the finest and coarsest woods alike yield to it, and articles of all values, sizes and uses can be completed with it, but good dove-tailing requires skill, the broad saw is in requisition, and it is not an easy tool in young hands. Again, both sides are not fashioned alike, and the thickness of wood used materially affects the work. It was no easy matter to get the teeth to fit well, and I for one destroyed many nicely prepared ends by a want of care in this last operation. Even after having successfully fitted your various pieces, the planing and rubbing that follow not unfrequently reveal a flaw in your work, but since no box imperfectly joined can be considered a perfect work nothing remains to be done but to submit cheerfully to the inevitable, and do the work over again. This strong box was made of birch wood. We were about two days making it, and had to be very careful when fixing it for planing, after putting the various pieces together, else we should have got our lines out of plumb—a little tapping with the mallet before the glue became firm would often set the thing right. We tested each corner with a set right angled rule kept for the purpose.

This strong box was followed by a rolling pin.

The thirtieth model. The axe and lathe are almost the only means used for this pin, which, though similar in size, differs in shape from the rolling pin of our English kitchen, the Swedish being smaller at the left hand than the right. Both the axe and lathe are to my mind difficult of manipulation. I must not forget a little work that occurs for the strengthening of the *biceps muscle.* In this model I refer to the hammering wanted to fix the wood into the hollow iron tube that goes in the revolving part of the lathe. Several hard blows, well directed, were wanted. This work is evidently more suited to boys than girls. But there are few things in the Slöjd that are not quite as well done by girls as boys, and many of those needing close application are, we learn, done infinitely better.

I now come to the thirty-first model—another boot-jack. At the risk of being prosy and troublesome, I will again call to your mind the excellent plan in this series of doing more than one article of a kind (allowing something different in between to break the monotony). We now turned to the making of our second boot-jack with a relish born of the desire to exceed our former efforts—affording as it did fuller scope for our ingenuity. All the sides of this model were not only planed but afterwards beautifully rounded. The foot gap was a horse-shoe curve, requiring files of different kinds; but the chief difference was in the feet, two holes were first bored, and for these we prepared with the lathe two prettily shaped pegs, which we drove into the holes with our mallets, afterwards making them fast with a wedge-shaped bit of wood put right across the upper part of the pegs; by the way, a carpenter, who very well understands his work, tells me that these wedges are a mistake, and were put in by our teacher because we had not been expert enough to fix tightly without—I do not believe him; but however it may be the work was of value to us, and we certainly never found that any patching was allowed, no bad or indifferent work ever passing out of the seminarium with the consent of the director.

The thirty-second model is a scoup very similar in size to that numbered *twenty-five*, but differing in shape, and consequently in the making. The inner part is rectangular; carved from a solid block, cut out with chisel, made to rest quite firmly on a table, the work is not different save in the matter of the bowl. The spoon-tool is not used at all in this spoon, but in order to get the inside smooth many hours are spent in polishing with the sand paper. The article is used for dry goods, such as flour, meal, sugar, &c. A kind of pine wood is used for it, and care should be taken that no knots occur. In making these hollow things two planings are necessary—one at first, as in the case of the parts of the box; and one afterwards. Need I add that a slight fault in fixing for planing may easily result in a broken side.

The thirty-third model, an axe handle in oak, curved in the centre, and, after the roughing out and sawing, completed almost entirely with the American plane. No wood seemed to want so much patience as oak, but from no other wood did we derive so much satisfaction; possibly this had to do with its home associations. The American plane needs a good deal of handling before it can be said to serve you, but when mastered I know of no more useful tool, you can get it round about anything in any curve or angle, and it occupies a sort of middle position between the knife and the plane. With this model I must end this month's paper.

(To be continued.)

—o—

Recent Inspection Questions.

Arithmetic.

STANDARD I.

(Dictated.)

1. 198 + 250 + 19 + 307 + 98.
872. Ans.

2. From 81 take 13. 68. Ans.

3. From 671 take 235. 436. Ans.

STANDARD II.

1. 9476 × 940. 8,907,440. Ans.

2. 20,097 ÷ 7. 2,871. Ans.

3. From 10,800 take 901. 9,899. Ans.

4. Add 4,009, 18,054, 408, 70,500, and 19.
92,990. Ans.

Another District.

1. From 56,402 take 9,127. 47,275. Ans.

2. Multiply 8,639 by 87. 771,593. Ans.

3. Divide 75,216 by 9. $8,357\frac{3}{9}$. Ans.

STANDARD III.

1. From £19,021 7s. 10½d. take £9,016 18s. 4d.
£10,004 9s. 6½d. Ans.

2. Divide ninety-seven thousand and eighteen by seven hundred and twenty-four. $134\frac{282}{724}$. Ans.

3. Mary had 4s. 6½d.; Jane had 5s. How much had one more than the other? 5½d. Ans.

4. A boy was sent to a shop with £3. He bought 18lbs. of tea at 2s. per pound, and spent 10s. for coffee. How much had he left for sugar?
£3 − (36s. + 10s.) = 14s. Ans.

B.

1. Divide nine hundred and ninety-eight thousand two hundred and thirty-two, by 87.
998,232 ÷ 87 = $11,473\frac{81}{87}$. Ans.

2. Take £2,998 18s. 9½d. from £3,004.
£5 1s. 2½d. Ans.

3. I bought two dolls at 1s., and three more at 8d. each. How much was left out of 5s. 6d.?
2s. 6d. Ans.

4. How many cakes, at 8 a penny, can I get for 3s. 4½d.? 324. Ans.

STANDARD IV.

1. Divide £1,620 12s. 9½d. by 73.
£22 4s. $0\frac{9}{4}\frac{38}{73}$. Ans.

2. Multiply £9 14s. 0½d. by 53.
£514 4s. 2½d. Ans.

3. Reduce twelve thousand eleven hundred and ten minutes to days. 12,000 + 1,110 = 13,110 mins.
9 days, 2 hours, 30 mins. Ans.

4. In 17 cwt. how many ounces?
30,464 ounces. Ans.

Another District.

1. Find the difference in £ s. d. between 20 guineas and 4,973 farthings.
£15 16s. 4¾d. Ans.

2. Divide £13,106 10s. by 67.
£195 12s. $4\frac{2}{67}$d. Ans.

3. Reduce 2,089,643 inches to miles.
32 m. 7 fur. 33 per. 3½ yds. 1 ft. 11 in. Ans.

4. Find the wages of 7 errand boys for a month (4 weeks) at 10½d. per day each, excepting Sundays.
£7 7s. 0d. Ans.

STANDARD V.

A.

1. If one Irish mile is equal to 1 mile 3 fur. 30 p. of English measurement, what is the length of 20,015 Irish miles in English measurement?
29,397 m. 0 fur. 10 poles. Ans.

2. $\frac{1}{2} - \frac{4}{5} + \frac{3}{4} - \frac{1}{3} + \frac{1}{6} + \frac{1}{2}$. $\frac{11}{12}$. Ans.

3. Mr. Jones and Mr. Brown bought 9,346 sheep. Mr. Brown paid £436 for 6,496 sheep. What would Mr. Jones pay for the rest at the same rate?

6496 : 2850 :: £436 : £191 5s. $8\frac{5}{6}\frac{6}{4}\frac{3}{9}\frac{2}{6}$d. Ans.

4. Make a bill for 3 salmon, each $30\frac{1}{4}$ lbs., at $5\frac{3}{4}$d. a pound; 100 herrings, at 2 for $1\frac{1}{2}$d.; 4 mackerel, at 4s. 6d. per doz.; 300 red herrings, at $\frac{1}{2}$d. each; 75 trout, at $11\frac{1}{2}$d. each.

(43s. $5\frac{3}{4}$d. + 6s. 3d. + 1s. 6d. + 12s. 6d. + £3 11s. $10\frac{1}{2}$d.)

£6 15s. $7\frac{1}{4}$d. Ans.

B.

1. If my net income, after paying 5d. in the £, was £184 16s. $4\frac{1}{4}$d., what was my gross income?

235 : 240 : £184 16s. $4\frac{1}{4}$d. : £188 15s. Ans.

2. 83489 @ £1 17s. $10\frac{1}{2}$d. each.

£158107 5s. $10\frac{1}{2}$d. Ans.

3. Make a bill for—

$4\frac{1}{2}$ yds. at $6\frac{1}{2}$d. per foot; 4 stones at 3s. 6d. per lb.; $8\frac{3}{4}$ lbs. at £1 6s. 8d. per lb.; 6,000 at 2s. 6d. per 100; 100 at 8s. 9d. for 75.

(7s. $3\frac{3}{4}$d. + £9 16s. + £11 13s. 4d. + £7 10s. + 11s. 8d.) = £29 18s. $3\frac{3}{4}$d. Ans.

4. If 7 men, working $12\frac{1}{2}$ hours a day, can do a piece of work in 9 days, how long would they be doing the same work by working $18\frac{3}{4}$ hours a day?

$18\frac{3}{4}$: $12\frac{1}{2}$ :: 9 : 6 days. Ans.

STANDARD VI.

A.

1. Reduce to a simple fraction $(\frac{1}{2} + \frac{1}{3}) - (\frac{5}{6} - \frac{3}{7})$

$\frac{89}{126}$. Ans.

2. Divide £100 among A, B, and C, so that A may get ·375, B ·125 of the whole, and C the remainder.

1 − (·375 + ·125) = ·5.

A, £37 10s., B, £12 10s., C, £50. Ans.

3. Find the interest on £840 for 6 months, at $3\frac{1}{4}$ per cent. £13 13s. 0d. Ans.

4. A room is $13\frac{1}{2}$ feet long and $11\frac{1}{4}$ feet wide. How many yards of carpet $2\frac{1}{4}$ feet wide will it take to cover it? $22\frac{1}{2}$ yds. Ans.

B.

1. Find the Simple Interest on £960 for 6 years at $4\frac{1}{2}$ per cent. £259 4s. 0d. Ans.

2. What decimal is 3s. 9d. of 8s. 9d.?

$\frac{45}{105} = \frac{3}{7} = \dot{4}2857\dot{1}$. Ans.

3. Find the value of $\frac{1}{10}$ of $\frac{5}{7}$ of 5s. 3d. + $3\frac{5}{11}$ of 14s. 8d. − $\frac{3}{4}$ of 5s. 6d.

$4\frac{1}{2}$d + 50s. 8d. − 3s. 8d. = £2 7s. $4\frac{1}{2}$d. Ans.

4. A man spends $\frac{1}{8}$ of his income in rent and taxes, and $\frac{1}{10}$ in charity, and has £341 left. How much is his income?

$1 - (\frac{1}{8} + \frac{1}{10}) = \frac{31}{40}$

31 : 40 :: £341 : £440. Ans.

STANDARD VII.

1. If a tobacconist buys 1 cwt. of tobacco for £18 13s. 4d., what must he sell it at per ounce so as to gain 20 per cent. on his outlay.

100 : 120 :: £18 13s. 4d. : £22 8s. 0d.

£22 8s. 0d. ÷ (112 × 16) = 3d. Ans.

2. If 77·25 of a class are over 7 years of age, and there are 99 under 7 years, what number does the class consist of? 400. Ans.

3. If one man walks 265 yards in 3 minutes, another 308 yards, and another 351 yards, what was the average number of miles per hour?

$\frac{1}{3}$ (265 + 308 + 351) × 20 = 6160 yds.

= $3\frac{1}{3}$ miles. Ans.

4. If 27 men build a wall 128 yards long in 20 days, how long will it take 37 men to build a wall 196 yards long?

days

37 : 27 :: 20 : $22\frac{10}{23}\frac{3}{6}$. Ans.

128 : 196.

Dictation.

STANDARD I.

Girl, noise, mile, dead, arms, chin, servants, window, April, vessel.

STANDARD II.

The soldiers marched on, and lo! late in the evening there came riding into the village a handsome young officer in splendid uniform, with a cross of honour on his breast, and asked to be led to the old man who had lent his cloak to the guide.

STANDARD III.

Goods manufactured in the neighbouring towns and villages are stored in the warehouses in the city. At these warehouses the merchants meet, and the buying and selling take place. The factories are large blocks of building many stories in height. They are ranged in immense rooms.

Grammar.

STANDARD V.

A.

(1.) Analyse the following sentence, and parse the words in italics:—

To comfort her *mourning son was her* great *desire.*

(2.) Form verbs from circle, tell, equal, roll, hopeless, and habitation.

B.

(1.) *Were ye born to be* an *hour's delight.*

(2.) Make nouns from insolvent, perfect, proclaim, secede, retrograde.

Geography.

STANDARD II.

(*Map of England before the class.*)

Pointing to sea, inspector asked:—What is this? (To land) And this? Show me a river. Which is its source? Its mouth? Which is widest, the mouth or source? Placing two reading books open on the desk thus—∧∧—he asked—If these were land what would they be called? What name would you

give to a long line of them? What is the low land between them called? What would you call a low flat country? Placing a penny on book—If this penny were land and the book water what would you call the land? If there were two islands near together, what would the narrow paesage of water between them be called? Point out a strait.

STANDARD III.

A.

What is the longest English river? What part of the country does it flow through? Where does it rise? Tell me the highest mountain in England and Wales? Tell me any other you know? If you stood on the top of Cross Fell, and looked to the right and left, what two seas would you see, supposing you could see far enough? What country would you see if you looked towards the north? What is the next longest river to the Severn? Name a town on its banks. What do you know about London? What do they call the country about the Wash? What is done to keep the sea back? What hills separate the Thames from the Severn? What name is given to that part of Yorkshire which embraces the woollen district? The children were asked to point out on the map the various places mentioned during the questioning.

B.

Pointing to town in which school was situated—What town is this? What town is near to it? What river would you cross to get to it? What do we manufacture in this neighbourhood? What minerals are found near us? Where do we send our coal to? Point out the way a ship would go in going to London Name the various parts of the sea the vessel would cross. When you see the picture of a cotton plant, what part of England does it remind you of? Why? What town is the most noted for its cotton goods? What do we make out of cotton? In what county do we carry on the woollen manufacture? What part of the county? In what towns? Where is the Black country? What do the people do in the Black country? What sort of a country is there in the west of Northumberland? Where does the Tyne rise?

STANDARD IV.

Name any of the seas round about British North America. What river flows into the Pacific? Into what strait does it flow? Name a river flowing into the Arctic Ocean? What lake is drained by a river flowing into Hudson Bay? What lakes are drained by the St. Lawrence? In what direction does the river flow? What is the Bay of Fundy famous for? Which is the most fertile part of the Dominion of Canada? What is the occupation of the people of Manitoba? What sort of soil is there in the district? What people are natives of this part of America? In what part do the Esquimaux live? What animal does the Indian hunt? What is a prairie? Where are the prairies? What is the character of the prairie? What is the north part of the Dominion called? What parts export great quantities of fish? What fish is exported? What fish is found in the rivers of Canada? Why are there so many Frenchmen in Canada? What English General was slain in taking it from France? At the taking of what town?

Science Notes.

THE Committee of the British Association which is appointed for the purpose of continuing the enquiries relating to the teaching of Science in Elementary Schools has issued its report. The main conclusion is that Science seems even to be losing the little footing which it had. The report goes on to say that the importance of technical instruction is making rapid progress in popular estimation, but this subject has not yet been recognised in elementary schools owing to the inaction of the Government. The Nottingham School Board has drawn up a memorial to the effect that it is very desirable that promising boys should receive some elementary manual instruction before the close of their school career. Indeed the board has already started a class but finds that two hours a week devoted to such instruction cannot be reckoned as an attendance for the purpose of article 12. The Department is now being strongly urged to sanction elementary technical instruction as part of the recognised school course and to allow payments for boys thus taught on the ground that the use of wood and iron tools is of as much importance to senior boys as needle-work and practical cookery are to girls. This is a very important matter especially in connection with the fact that when boys have passed Standard VII., no further grant can be earned from the department on their behalf. Some at least of such children, perhaps many, would be kept at school a year longer if they were taught the use of a few of the commoner tools. In regard to a question of this sort it is wise to move cautiously. There can be no doubt that a strong desire for instruction in the use of tools is springing up in the country, and ere long some steps will be taken to meet it. A little manual work will be good both for mind and body and boys will grow up better able to make their way in the world and to supply some of their commoner wants.

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THERE are few applications of Science in which the progress has been so rapid and continuous as in Photography. Boyle noticed that silver salts were blackened on exposure to light, and Wedgwood obtained pictures of leaves in 1802 by the action of light on paper and leather moistened by silver nitrate. These pictures, however, were of little value as they were completely blackened by exposure to daylight. Niepce and Daguerre in 1826 worked at the subject together and in 1839 the process since known as the Daguerreotype was invented. A surface of polished silver is exposed to the vapour of iodine and thus coated with a film of iodide of silver which is acted upon by light as readily as the chloride. The picture does not make its appearance till it is acted upon by the vapour of mercury. Extremely fine globules of mercury are deposited on those portions of the plate where the light has been allowed to fall. If the plate is then immersed in some solution like hyposulphite of soda (sodium thiosulphate), which will dissolve out the silver iodide unacted upon by light, the picture becomes permanent. Very beautiful pictures were taken by this process and are as good now as they were forty years ago. Fox Talbot succeeded in taking pictures on paper in 1841, but a much more important advance was made by Archer, who used as

the sensitive agent an iodized collodion film upon a glass plate. This plate required to be developed by the means of some such solution as ferrous sulphate. The picture, which is a negative, can then be printed from.

It was known from the first that the violet rays of the spectrum were most active in affecting salts of silver, and to these rays and the invisible ones of higher frequency, the name of chemical or actinic rays was given. But it is known now that chemical effects may be produced by all the rays of the spectrum. Indeed Photography has been one of the very instruments used in investigating the infra red rays of the solar spectrum. These dark or heat waves as they are often called have been found capable of bringing about chemical changes in heavy complex chemical molecules. A plate has recently been brought to perfection by the addition of aurin to the bromide film which is very sensitive to the yellow part of the spectrum. This light is of great intensity and the result is that pictures can be taken in an almost incredibly short time with an amount of sharpness and fulness of detail which is truly astonishing. There are few pursuits which are more thoroughly within the power of an intelligent amateur than photography. Modern improvements have made it possible to multiply objects of interest and beauty, and to bring home and retain for future reference fair copies of what can only be occasionally studied at first hand.

***

SOME Students possess special aptitudes for manipulation. They do nothing clumsily and when they set up an ordinary piece of apparatus it is always neat, simple, and effective. We should like to commend to such enthusiasts a little book (only 80 pages) which has recently come into our hands. It is called 'The Methods of Glass-blowing' by W. A. Shenstone. There is hardly a laboratory without its blow-pipe apparatus. More instruction, however, is wanted than is usually given to the subject, and the practical directions in Mr. Shenstone's manual will go far to supply the need now felt. The student will hardly dare to hope to perform all the feats described in the book. He may well regard some of them as Hume did the style of Gibbon—with mingled admiration and despair. We are quite sure that the book was much wanted. It is handy, cheap, and useful. Those who buy it will be glad their attention was called to it.

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In connection with the Exhibitions at South Kensington it now seems likely that we shall have a National Science Collection. A Museum of Science was contemplated as a part of the Science and Art Department, 1853, but the Art collections have gradually ousted the scientific objects. A very competent committee of eminent scientific men have reported that the present objects are suitable for the nucleus of the contemplated museum in regard to Chemistry, Physics, Mechanics, Metallurgy, Geology and Mineralogy, Astronomy, Mineralogy, Geography, Agriculture, and Biology. There are also Naval Models, a Structural Collection, and a collection illustrative of fish culture. Educational objects also are well represented, and distinguished Educationists have stated that these would be of great value to School Boards, Managers and Teachers. This is encouraging. To many people the announcement that it is decided to erect the building at South Kensington will be a disappointment. Accessibility is undoubtedly a matter of the first importance, and it cannot be maintained that South Kensington is easy of access to the bulk of those who are likely to make use of these collections. We fear that there is no help for it. Land is dear in the vicinity of Charing Cross and no proposal to spend a quarter of a million in purchasing a site is likely to be entertained by those who will be responsible for the carrying out of the new scheme.

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher, Pilgrim Street, Ludgate Hill, London, E.C.*

General.

1. ARWYDBODUS.—French is not a separate subject now. There are groups of subjects. School management is compulsory, and in regard to acting teachers two other groups, History, and Geography, and Mathematics are also compulsory, unless the candidate has passed in them satisfactorily in the first year's papers; hence they cannot take either the Science or the Language group, but they can take as many groups as anybody else.

2. CECIL.—You will find full proofs of both in *Todhunter's* 'Plane Trigonometry,' page 188.

3. J. E.—You may use a book reviewed in this number of this magazine on vocal power. It may be of considerable service to you. You write with the edge of the pen, and therefore produce jagged lines; you require to imitate good copies attentively, and write less upright. Try the early numbers of Hughes' New Copybooks, by *Cowham*. 65. Your small hand is large hand 'writ small.' There are recognised shapes for small hand; you must use them. Until you have mastered the elements you must not try to be original. Your writing is legible, and it could be improved greatly by two hours careful practice a week for a quarter. But there must be a definite purpose in view. 65.

4. DUNELM.—In taking a handful of shot from a bag show that the chance of getting an even number is greater than the chance of getting an odd number. (*Atkins'* 'Pure Mathematics.')

In regard to this query the reverse is the case.

For, if the number of shot were even, the odd numbers would equal the even numbers, and thus the chances would be equal.

Whereas, if the number were odd, the odd numbers would be greater than the even numbers by unity, and thus the chance of drawing an odd number would be greater than the chance of drawing an even number.

5. W. J. PRICE. — Write to the Registrar of the London University, Piccadilly, and ask for a copy of the Syllabus. It will be sent to you gratis and post free. You will then see exactly what is required. Suitable editions of the classical subjects were in some cases advertised on the first page. The arithmetic you name contains enough. Add to your list, which is a little old-fashioned, *Hall's* 'Algebra' (Macmillan), *Mackay's* 'Euclid' (Chambers), *Abbott's* 'Via Latina,' *Dr. Smith's* 'Smaller Latin Grammar, 'English Grammar Language,' by Canon *Daniel*. For a good deal of useful information as to books and methods, refer to the articles in the PRACTICAL TEACHER, from April to December, 1884.

6. D. A.—Try *Ever's* book on 'Navigation,' and 'Nautical Astronomy,' by *Merrifield*. For Geology you will find *Jukes-Browne's* Manual a most excellent guide. Study that first and handle as many specimens as you can.

7. A. THIRD YEAR'S P. T.

KIND OF SENTENCE	CONNECTIVE	SUBJECT	PREDICATE	COMPLETION	EXTENSION OF PRED.
					on the jag of a mountain crag (place) one moment (time) in the light of its golden wings (place)
Adverbial Sentence to 'leaps' in the previous sentence in the poem	as (*a*)	an eagle	may sit		
Adjective Sentence to (*a*)	(*b*)	an earthquake	rocks	which	
Adjective Sentence to (*a*)	and (*c*)	an earthquake	swings	which	

8. TAL.—Prove the following relations :—

(*a*) $\dfrac{\sin(\alpha+\beta)}{\sin\alpha+\sin\beta} = \dfrac{\cos\frac{\alpha+\beta}{2}}{\cos\frac{\alpha-\beta}{2}}$;

(*b*) $\tan\alpha = \operatorname{cosec} 2\alpha - \cot 2\alpha$.

(*a*) $$\frac{\sin(\alpha+\beta)}{\sin\alpha+\sin\beta} = \frac{2\sin\frac{\alpha+\beta}{2}\cos\frac{\alpha+\beta}{2}}{2\sin\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2}} = \frac{\cos\frac{\alpha+\beta}{2}}{\cos\frac{\alpha-\beta}{2}}.$$

(*b*) $\operatorname{Cosec} 2\alpha - \cot 2\alpha = \dfrac{1}{\sin 2\alpha} - \dfrac{1}{\tan 2\alpha}$;

now, $\sin 2\alpha = 2\sin\alpha\cos\alpha$

$$= \frac{2\sin\alpha\cos\alpha}{\sin^2\alpha+\cos^2\alpha} \quad \text{(Denomination = unity.)}$$

$$= \frac{\frac{2\sin\alpha}{\cos\alpha}}{1+\frac{\sin^2\alpha}{\cos^2\alpha}} \quad \text{(Dividing by } \cos^2\alpha.\text{)}$$

$$= \frac{2\tan\alpha}{1+\tan^2\alpha};$$

$$\tan 2\alpha = \frac{2\tan\alpha}{1-\tan^2\alpha};$$

$$\therefore \operatorname{cosec} 2\alpha - \cot 2\alpha = \frac{1+\tan^2\alpha}{2\tan\alpha} - \frac{1\tan^2\alpha}{2\tan\alpha}$$

$$= \frac{2\tan^2\alpha}{2\tan\alpha}$$

$$= \underline{\tan\alpha}.$$

Mensuration.

1. SOMERSET.—An oblong reservoir 20 feet deep is 275 feet long and 210 feet broad at the top, and 198 feet long and 128 feet broad at the bottom. How many cubic feet of water will it hold when full?

Volume of frustrum of pyramid

$$= (a^2 + ab + b^2) \times \frac{\text{height}}{3},$$

where a^2 and b^2 represent the areas of the two ends.

$\therefore$ Content of reservoir

$= \left[\left\{(275\times210) + \sqrt{275\times210\times198\times128} + (198\times128)\right\} \times \frac{20}{3}\right]$ cub. feet.

$= [(57{,}750 + \sqrt{1{,}463{,}616{,}000} + 25{,}344) \times \frac{20}{3}]$ cub. feet.

$= [(83{,}094 + 38{,}257{\cdot}2346\ldots) \times \frac{20}{3}]$ cub. feet.

$= (121{,}351{\cdot}2346 \times \frac{20}{3})$ cub. feet.

$= (2{,}427{,}024{\cdot}692 \div 3)$ cub. feet.

$= \underline{809{,}008{\cdot}23\ldots \text{ cub. feet.}}$ Ans.

Algebra.

1. BUSHMAN.—What amount of money at itself per cent. will amount to £78 8s. in two years at compound interest?

Let x = Sum in pounds;

Then, $x + \left(x \times \frac{x}{100}\right) + \left[\left\{x + \left(x \times \frac{x}{100}\right)\right\} \times \frac{x}{100}\right] = 78{\cdot}4$

$$x + \frac{x^2}{100} + \frac{x^2}{100} + \frac{x^3}{10000} = 78{\cdot}4$$

$$x + \frac{x^2}{50} + \frac{x^3}{10000} = 78{\cdot}4$$

$$10{,}000x + 200x^2 + x^3 = 784{,}000$$

$$x^3 + 200x^2 + 10{,}000x - 784{,}000 = 0$$

$$(x-40)(x^2+240x+19{,}600) = 0$$

From $x - 40 = 0$

we obtain $\underline{x = 40}$

$$x^2 + 240x + 11{,}600 = 0$$

$$x^2 + 240x + (120)^2 = 14{,}400 - 19{,}600$$

$$= -5{,}200$$

This gives *impossible* values for x.

$\therefore$ Sum = $\underline{£40}$.

2. MARK TWAIN.—Solve:—

$$\frac{\sqrt{a^2-x^2}-\sqrt{b^2+x^2}}{\sqrt{a^2-x^2}+\sqrt{b^2+x^2}} = \frac{c}{d}. \quad \textit{(Colenso.)}$$

$$\frac{\sqrt{a^2-x^2}-\sqrt{b^2+x^2}}{\sqrt{a^2-x^2}+\sqrt{b^2+x^2}} = \frac{c}{d}$$

$$\left.\begin{matrix}\text{denominator + numerator}\\ \text{denominator − numerator}\end{matrix}\right\}$$

$$\frac{2\sqrt{a^2-x^2}}{2\sqrt{b^2+x^2}} = \frac{d+c}{d-c}$$

$$\frac{a^2-x^2}{b^2+x^2} = \frac{c^2+2cd+d^2}{c^2-2cd+d^2}$$

$$\left.\begin{matrix}\text{numerator}\\ \text{numerator + denominator}\end{matrix}\right\}$$

$$\frac{a^2-x^2}{a^2+b^2} = \frac{(c+d)^2}{2(c^2+d^2)}$$

$$a^2-x^2 = \frac{a^2(c+d)^2+b^2(c+d)^2}{2(c^2+d^2)}$$

$$x^2 = a^2-\frac{a^2(c+d)^2+b^2(c+d)^2}{2(c^2+d^2)}$$

$$= \frac{a^2(c-d)^2-b^2(c+d)^2}{2(c^2+d^2)}$$

$$\therefore\ x = \pm\sqrt{\frac{a^2(c-d)^2-b^2(c+d)^2}{2(c^2+d^2)}}.$$

3. PUZZLED.—Extract the square root of:—

$$5+\sqrt{6}+\sqrt{10}+\sqrt{15}.$$

Assume, $\sqrt{5+\sqrt{6}+\sqrt{10}+\sqrt{15}} = \sqrt{x}+\sqrt{y}+\sqrt{z}$

Then, $5+\sqrt{6}+\sqrt{10}+\sqrt{15} = x+y+z+2\sqrt{xy}+2\sqrt{yz}+2\sqrt{zx}$

$$\left.\begin{matrix}\text{Put, } 2\sqrt{xy} = \sqrt{6}\\ 2\sqrt{yz} = \sqrt{10}\\ 2\sqrt{zx} = \sqrt{15}\end{matrix}\right\} \quad (1),\ (2),\ (3)$$

$$(1)\times(2)]\quad 4\sqrt{xy^2z} = \sqrt{60} \qquad (4)$$

$$(4)\div(3)]\quad 2\sqrt{y^3} = \sqrt{4}$$

$$2y = 2$$

$$\therefore\ y = 1.$$

$$(1)\quad 2\sqrt{xy} = \sqrt{6}$$

$$2\sqrt{x} = \sqrt{6}$$

$$4x = 6$$

$$\therefore\ x = \tfrac{3}{2}.$$

$$(2)\quad 2\sqrt{yz} = \sqrt{10}$$

$$2\sqrt{z} = \sqrt{10}$$

$$4z = 10$$

$$\therefore\ z = \tfrac{5}{2}.$$

The values of x, y, and z satisfy the equation:—

$$x+y+z = 5.$$

$$\therefore \text{ Square root} = \sqrt{\tfrac{3}{2}}+\sqrt{1}+\sqrt{\tfrac{5}{2}}$$

$$= \underline{1+\sqrt{\tfrac{3}{2}}+\sqrt{\tfrac{5}{2}}}. \text{ Ans.}$$

4. EXPLORATOR.—Solve:—

$$\left.\begin{matrix}x^4-y^4 = a\\ x-y = b\end{matrix}\right\}$$

$$\left.\begin{matrix}(1)\ x^4-y^4 = a\\ (2)\ x-y = b\end{matrix}\right\}$$

From (2) $y = x-b$

$$\therefore (1)\ x^4-(x-b)^4 = a$$

$$x^4-(x^4-4bx^3+6b^2x^2-4b^3x+b^4) = a.$$

$$4bx^3-6b^2x^2+4b^3x-a-b^4 = 0$$

$$x^3-\frac{3b}{2}x^2+b^2x-\frac{a+b^4}{4b} = 0$$

Put $x = z+\frac{b}{2}$

Then, $\left(z+\frac{b}{2}\right)^3-\frac{3b}{2}\left(z+\frac{b}{2}\right)^2+b^2\left(z+\frac{b}{2}\right)-\frac{a+b^4}{4b} = 0$

$$z^3+\frac{3b}{2}z^2+\frac{3b^2}{4}z+\frac{b^3}{8}-\frac{3b}{2}\left(z^2+2bz+\frac{b^2}{4}\right)+b^2z+\frac{b^3}{2}-\frac{a+b^4}{4b} = 0$$

$$z^3+\frac{3b}{2}z^2+\frac{3b^2}{4}z+\frac{b^3}{8}-\frac{3b}{2}z^2-3b^2z-\frac{3b^3}{8}+b^2z+\frac{b^3}{2}-\frac{a+b^4}{4b} = 0$$

$$z^3-\frac{5b^2}{4}z-\frac{a}{4b} = 0$$

In the equation:—

$$z^3+qz+r = 0$$

By Cardan's Method:—

$$z = \left(-\frac{r}{2}+\sqrt{\frac{r^2}{4}+\frac{q^3}{27}}\right)^{\frac{1}{3}}+\left(-\frac{r}{2}-\sqrt{\frac{r^2}{4}+\frac{q^3}{27}}\right)^{\frac{1}{3}}$$

Hence in the given equation:—

$$z = \left\{\frac{a}{4b}\times\tfrac{1}{2}+\sqrt{\left(\frac{a}{4b}\right)^2\times\tfrac{1}{4}+\left(\frac{5b^2}{4}\right)^3\times\tfrac{1}{27}}\right\}^{\frac{1}{3}}$$

$$+\left\{\frac{a}{4b}\times\tfrac{1}{2}-\sqrt{\left(\frac{a}{4b}\right)^2\times\tfrac{1}{4}+\left(\frac{5b^2}{4}\right)^3\times\tfrac{1}{27}}\right\}^{\frac{1}{3}}$$

$$= \left\{\frac{a}{2b}+\sqrt{\frac{a^2}{64b^2}+\frac{25b^4}{432}}\right\}^{\frac{1}{3}}$$

$$+\left\{\frac{a}{2b}-\sqrt{\frac{a^2}{64b^2}+\frac{25b^4}{432}}\right\}^{\frac{1}{3}}$$

$$= \left\{\frac{a}{2b}+\sqrt{\frac{27a^2+100b^6}{1728b^2}}\right\}^{\frac{1}{3}}$$

$$+\left\{\frac{a}{2b}-\sqrt{\frac{27a^2+100b^6}{1728b^2}}\right\}^{\frac{1}{3}};$$

$$\therefore\ x = \left\{\frac{a}{2b}+\sqrt{\frac{27a^2+100b^6}{1728b^2}}\right\}^{\frac{1}{3}}$$

$$+\left\{\frac{a}{2b}-\sqrt{\frac{27a^2+100b^6}{1728b^2}}\right\}^{\frac{1}{3}}$$

$$+\frac{b}{2}.$$

Arithmetic.

1. EXCISE.—A company declares a dividend of $7\frac{1}{2}$ and $5\frac{1}{2}$ per cent. on stocks A and B respectively. If the same dividend were paid on both, it would amount to 6 per cent. If there is half-a-million A, how much B is there?

Difference between $7\frac{1}{2}$ % and 6 % on A stock
$= 1\frac{1}{2}$ % on £500,000
$=$ £7,500;

Difference between 6 % and $5\frac{1}{2}$ % on B stock
$= \frac{1}{2}$ % on B stock;

$$\therefore \text{ Amount of B stock} = £7{,}500\times\frac{100}{\frac{1}{2}}$$

$$= £7{,}500\times 200$$

$$= £1{,}500{,}000$$

$$= \underline{1\tfrac{1}{2}\text{ millions.}} \quad \text{Ans.}$$

2. ZEUS.—An express train, which ought to travel at a uniform speed, after being an hour in motion, was delayed half-an-hour by an accident, after which it proceeded at three-fourths of its original speed, and in consequence arrived at the end of its journey 1 hour 50 minutes behind time.

Had the accident occurred (and the same delay and retardation taken place) after the train had travelled a distance of 60 miles, it would have been 1 hour 40 minutes behind time. Find the length of the line. (*Piper's* 'Advanced Arithmetic.')

Difference in the times of arrival = 10 min. = $\frac{1}{6}$ hr.;

$$\therefore\quad \left(1+\frac{60-\text{rate}}{\frac{3}{4}\text{ rate}}\right)-\frac{60}{\text{rate}} = \tfrac{1}{6}$$

$$1+\frac{60}{\frac{3}{4}\text{ rate}}-\frac{\text{rate}}{\frac{3}{4}\text{ rate}}-\frac{60}{\text{rate}} = \tfrac{1}{6}$$

$$1+\frac{80}{\text{rate}}-\tfrac{4}{3}-\frac{60}{\text{rate}} = \tfrac{1}{6}$$

$$1 - 1\tfrac{1}{3} + \frac{80}{\text{rate}} - \frac{60}{\text{rate}} = \tfrac{1}{6}$$

$$-\tfrac{1}{3} + \frac{20}{\text{rate}} = \tfrac{1}{6}$$

$$\frac{20}{\text{rate}} = \tfrac{1}{6} + \tfrac{1}{3}$$

$$= \tfrac{1}{2}$$

$$\therefore \text{ Rate } = 20 \times 2$$

$$= 40 \text{ miles.}$$

$$\frac{\text{distance}}{\text{rate}} = \frac{60}{\text{rate}} + \frac{\text{distance} - 60}{\frac{3}{4} \text{ rate}} + \tfrac{1}{2} - 1\tfrac{1}{3}$$

$$\therefore \frac{\text{distance}}{40} = \tfrac{60}{40} + \frac{\text{distance}}{\frac{3}{4} \text{ of } 40} - \frac{60}{\frac{3}{4} \text{ of } 40} - 1\tfrac{1}{6}$$

$$\frac{\text{distance}}{40} = 1\tfrac{1}{2} + \frac{\text{distance}}{30} - \tfrac{60}{30} - 1\tfrac{1}{6}$$

$$= \tfrac{1}{3} + \frac{\text{distance}}{30} - 2$$

$$= \frac{\text{distance}}{30} - \tfrac{5}{3}$$

$$\frac{\text{distance}}{30} - \frac{\text{distance}}{40} = \tfrac{5}{3}$$

$$\frac{4 \text{ times distance} - 3 \text{ times distance}}{120} = \tfrac{5}{3}$$

$$\frac{\text{distance}}{120} = \tfrac{5}{3}$$

$$\therefore \text{ Distance } = 120 \times \tfrac{5}{3}$$

$$= \underline{200 \text{ miles.}} \text{ Ans.}$$

—o—

Publications Reviewed.

A Syllabic System of Teaching to Read.

G. Bell and Sons, York Street, Covent Garden.

This is a small volume of thirty-two pages, on the syllabic teaching to read. A few lessons are given at length as specimens. Thus, on the ending *ad* the following words are brought in—dad, lad, bad, sad, mad, pad, fad, had, shad. From pages 20 to 32 the book consists of lists of words arranged according to their endings, to serve as the bases of lessons such as those given in the earlier part of the book. These lists may be useful occasionally, but the selection of words is often, to say the least, injudicious and unfortunate. In the search for words which would rhyme with others, the author seems to have forgotten that it is wrong to burden a child's memory with words that it will not use for years. But most persons will agree that there are scores of words in the volume before us which a child had better not learn at all, much less in its earlier years. We will give some examples of the words which we refer to:—fuddle, caliph, thrum, smock, whack, hell, mash, mush, quoth, strath, shard, sherd, gulch, chump, scamp, wench, dung, stink, stunk, skunk, chunk, grunt. What can be the object of storing a child's mind with useless lumber of this sort? We hope these words, and some scores like them, will be struck out when a second edition is called for.

The author tells us that many teachers are unacquainted with methods devised to lessen children's difficulties in learning to read English. Most, he says, begin by teaching their pupils to learn by heart, and name at sight the letters of our alphabet. Who can these teachers be? They are certainly not the teachers in the elementary schools of this country. It is not by methods utterly wrong or antiquated that the children in primary schools are taught to read easy books at the age of seven, and moderately difficult ones at the age of nine. Those, however, who do teach reading in the way described will find some valuable hints in the volume before us. They can select the words that they would like their children to learn and leave the others out.

Ranke's Latin and Teutonic Nations, 1494—1514.

Translated by Philip A. Ashworth. George Bell and Sons.

Though Bohn's name no longer stands at the bottom of the title pages of modern histories and translations, yet it still lives, for here we have a volume published as belonging to his celebrated Standard Library. We almost regret that Messrs. Bell and Sons have discarded the well-known, though not very attractive blue case, so familiar to us for so many years, and which, by the way, was so faithfully reproduced by Messrs. Harper, of New York, in which to issue their reprints.

This is not Mr. Ashworth's first attempt at translating the German classics, having already prepared for English readers Gneist's Constitutional History of England.

The translator tells us in his very modest and nicely written preface that in his scrupulous fidelity to reproduce the original as nearly as could be, he has sacrificed all literary style, and this we can well believe. Before the great historian's death Mr. Ashworth had the advantage of conferring with him on the method he wished adopted, and at the end of his preface he reproduces, as well as he can remember, a remarkable sentence of the old man's, which was practically a criticism on Sir Walter Scott, as to the way in which he, Sir Walter, contorted historical facts for the purpose of his fictions.

There are some eighteen pages of introduction, giving the outlines of a treatise upon the unity of the Latin and German nations, and their common development, which is perhaps the most readable part of the book.

The work itself is a closely printed volume of 380 pages, and interesting as it is, and valuable, as a synoptic view of the history of the times, still we are bound to add it is very hard reading.

It is moreover at times quite difficult to know to which of the names lately mentioned the different personal and demonstrative pronouns refer.

We cannot help thinking, too, that dates might be inserted at the top of each page with great advantage.

In conclusion, we welcome the translation most heartily, and recommend those of our readers who care to study history from a philosophical point of view to get the work and study it.

Greek Testament Selections for the use of Schools.

By H. M. M. Stedman, M.A. G. Bell and Sons.

This is a good idea well carried out. The selections have been so arranged as to form a brief chronicle in Greek of the most important events in the life of Christ. It is not possible for boys to read much of the New Testament in the original in the short time usually devoted to that subject. Many of the most characteristic passages of the Gospels are, therefore, never reached if the chapters are read consecutively. In the book before us Mr. Stedman has compressed 140 very striking and impressive quotations into 64 pages. Where masters are quite free to choose the work to be done in their schools, they will find these selections very useful. Private students who wish to read some New Testament Greek could hardly do better than read the passages here collected before proceeding further. The type is excellent, the paper and binding very good.

Elements of Comparative Grammar and Philology.

By A. C. Price, M.A. Geo. Bell and Sons.

This book is designed mainly for the aid of boys who are preparing for scholarship examinations at Oxford or Cambridge. It is intermediate between such books as Mr. Peile's Primer and Mr Papillon's Manual. The author claims no originality either of matter or method His object has been to summarize the views of the recognized authorities as concisely and clearly as possible.

The book consists of ten chapters which occupy 120 pages. The subjects are judiciously chosen and ably dealt with. A very large amount of important information is stated clearly and concisely. At the end of the chapters a number of authorities are given, which the more industrious boys might like to consult. Facilities for doing so are afforded by the references to the particular passages in question. We are sure this unambitious but useful book will be much appreciated by those for whom it is written. We hope it may have a wide circulation.

In a subject like Philology much may be urged against the omission of certain points of interest to individual readers, but no doubt more may be urged on the other side. The question of the pronunciation of ancient Greek and Latin is often cropping up, and we think the author could enlarge the section devoted to it in a second edition. Educationally, it is a matter of the greatest practical importance that a boy who is beginning to learn a language should pronounce the words so as to have nothing to unlearn afterwards. Anything, therefore, that tends to educate our masters up to the point of agreement among themselves, has a direct bearing upon education. It is simply a scandal that the pronunciation of Latin and Greek should in England still be an open question.

Exchange of Foreign Monies to Pounds Sterling. By Charles Hoare. David Nutt.

This is a little work prepared for those who are engaged in monied transactions with foreign countries.

With the exception of the first eight pages, the book consists of tables, showing the value in £'s (the shillings and pence being expressed as decimals of a £) of 100 francs, 100 marks, and 100 dollars, according to the possible rates of exchange, varying from 24·90 francs, 19·20 marks, and 4·50 dollars to 26·125 francs, 21·12 marks, and 5·15½ dollars.

The first eight pages contain some seven notes, or rules as they are called in school arithmetics. These rules are happily accompanied by some examples, to the different parts of which are explanations or rather references to the wording of the rules. We use the word 'happily' advisedly, for we very much doubt if the following statement by itself would teach an unthinking clerk how to write down the shillings and pence from the decimal of a £.

Rule.—Deduct the first figure always ; also 5 from the second place if it contain 5, or more than 5, and double the number so deducted for shillings, &c.

We maintain that this, as written, implies that £21·175 represents £21 12s. and some pence.

At the side of the tables there are examples worked out, and others given for practice.

As a practical book we can well believe it would be very useful ; but as an educational work it would be of no use, except to teachers, for verifying the results of their pupils' work in the somewhat difficult subject of exchange.

How to Develop General Vocal Power. Rev. J. P. Sandilands, M.A.

This is a little book of 72 pages, on how to develop general vocal power, and cure stammering and defective speech. It is clear, concise, and practical. We cordially recommend it to any who have defective utterance. We do not think the preface is a necessary part of the book, and we are not able to agree with the author upon the questions he raises in it. We are decidedly of opinion that there are many people whose speaking is all that could be desired, and who at the same time have never been specially taught, while there are others to whom much more attention has been given who illustrate nearly all the defects of speech.

The author is hard upon systems, whether of work for examinations or payment by result. The only point of general interest is that in his opinion estimation by results would be quite as pernicious as payment by results. Who will find a perfect system?

Euripides' Hecuba. White's Grammar School Texts. Longmans, Green, and Co.

Dr. White's Grammar School Texts are now so well known, so widely used, and so highly appreciated that we need do no more than say that the 'Hecuba' is worthy of being placed beside the best of the editions yet issued. The vocabulary is of the usual full, clear, and accurate kind.

Euripides' Medea. With Introduction and Notes by C. B. Heberden, M.A. Part I.

This is a very handy and excellent edition of the 'Medea.' There are two parts. The first contains an introduction and the text, and the second the notes. The type is very clear and printed upon good paper. Candidates for examinations where the Medea is set can hardly do better than get this edition of the play. It supplies all that can be fairly expected without overburdening them with what is of no immediate use to them.

Musical Drill for Infants. By A. Alexander. G. Philip and Son, Fleet Street.

This is an admirable book of exercises for young children. For infants, for girls, and for junior boys nothing could be better than the interesting and healthful physical drill which the director of Liverpool Gymnasium has put within the reach of every teacher. The book contains about eighty pages, half of which consist of music to which the exercises can be performed. The illustrations are abundant and very well executed, and the printing and binding all that can be desired. We strongly recommend the book. We are sure it will give satisfaction to the teachers who use it, and provide many happy hours for the children who are fortunate enough to be taught the exercises it contains.

French Principia. Part III. An Introduction to French Composition. By the Rev. P. H. E. Brette, B.D.

This book has been advertised for many years. It has appeared at last, and well justifies the time it has taken to produce it. It is a book of 370 pages, and is intended to teach pupils to write French sufficiently well to pass the B.A. degree in the University of London. There are two parts, the first consisting of rules, hints, and notes on construction and idiom, and the second of exercises, which are arranged in systematic progression. In looking over the first part one is struck with the abundance and completeness of the illustrations. This is especially noticeable in regard to the sections on verbs requiring certain prepositions to follow them, and perhaps more still in the list of English verbs which are differently rendered into French according to the particles by which they are accompanied. The treatment, too, of the prepositions—always a crucial point in a book on composition—is very full and satisfactory.

References to rules abound in the exercises, and the pupil is taught how to help himself, which he is afterwards expected to do. The whole book is brimful of information. Idioms and proverbial phrases accompany each of the 150 exercises. One feels a little misgiving upon laying the book down lest its very completeness should stand in the way of its usefulness. A book, however excellent, is apt to dishearten a pupil if it contains too much. It must, of course, be remembered that it is an advanced text-book. Candidates for a degree in a university and the upper classes in schools will find it an excellent companion. The type strikes us as rather small, and here and there the pages are overcrowded.

There can be no doubt but that this book will be as great a success as the French Reader by the same author. Those who have used the French Principia, Part II., will know what to expect, and they will find Part III. in every respect a fitting sequel to the Reader.

Lessons in Elementary Dynamics. Arranged by H. G. Madan, M.A. W. R. Chambers.

This is an endeavour to explain some of the properties of matter, laws of motion, and the modern conceptions of energy and work in such a manner as involves only the most elementary knowledge of mathematics. The author has drawn his illustrations from the phenomena of practical life and the games which boys enjoy. An intelligent boy will find this book a capital introduction to physics in general. There really seems to be no necessity why the author should avoid simple algebra and geometry in works like this. Boys who read a little natural philosophy have almost invariably learned the rudiments of Algebra and Euclid, and are pleased to see them turned to useful account.

The author says a beginner wants precise definitions of terms, and cannot easily pick out what he wants from such casual mention or diffuse explanation of them as appears sufficient to many writers. This is quite true. We would go further, and ask for something like uniformity in the wording of the definitions used in elementary text-books. Why every writer should feel at liberty to give a new rendering of an old definition, teachers can never quite understand. It is a considerable obstacle to a boy's progress. We should have been glad if still more attention to definition had been bestowed on the work before us. Acceleration is defined as 'the quickening of speed caused by the continued action of a force.' Suppose a boy learns this by heart, it may prove a positive hindrance to him afterwards. He must, at least, unlearn it some day. Now definitions may perhaps have to be incomplete at certain stages of a pupil's knowledge, or even of a teacher's knowledge; but we ought to frame them so that they are accurate as far as they go. Again, on page 91 we read that the acceleration produced by gravitation is 32 feet per second; but the author knows perfectly well that acceleration can never be properly expressed in feet per second. There is no error more common than expressing acceleration in feet per second, and it would be a wonder if it were otherwise when competent writers think such an inaccuracy does not matter in the case of beginners. There is no difficulty in getting the correct notion into a boy's head. The illustration of his going to work for five shillings a week, to rise by a shilling a week, is quite sufficient, if well used, to make the matter clear. Is the rise of wage to occur once a year, once a month, or once a week? All depends on that, and he can soon be made to see its application to acceleration.

We are sorry the author did not use the metric system, the importance of which he is evidently alive to. If only the eminent scientific men of the country would agree to use the metric system in their writings and lectures, it would be accepted in a short time, to the enormous gain of all who afterwards made any branch of exact science their vocation or even their amusement.

Manual for the English Girls' Garten. Household Object Lessons—First Course: Teaching Methodical Daily Work. John Heywood, Manchester.

This little book is one of many illustrations of the way in which the recently awakened interest of divers minds in educational matters is showing itself, in the endeavour to aid the solution of one of the great problems of the day. It is a well meant effort to show how girls should be taught a most important part of their future duty. But it is to a large extent wanting in practical adaptation to the real requirements and the resources of an ordinary school teacher's daily work. It may not, however, be intended for such, being 'Dedicated to the Teachers of our Little Women, and to the English Girls' Garten Association. The peculiar use of the German word, as well as much of the method suggested, seems to indicate the purpose of carrying out the spirit and the mode of Froebel's work among little children.

The intent of the authoress of this work is a good one, *viz.*, to train the girls of poor families to a liking for household work, and to method and order in its execution. This is set forth in a kindly, but curiously worded introduction, addressed 'to my fellow helpers.' The spirit and temper inculcated are excellent, but that the writer has only a very partial view of the requirements of practical instruction may be fairly surmised from this remarkable injunction: 'Do not give them (children) information, extract it from them; this makes all the difference between parrots and human thinking beings.' What it is that 'makes all the difference' is not obvious. Whether it be that parrots 'give,' while 'human thinking beings' 'extract' information; or that parrots have it given while human beings have it extracted, is not more clearly indicated than is the source whence the children are to get the information which the teacher is prohibited from giving. Such half-truths, and such forms of expression, have an imposing sound, but they mar the effect of much that is sensible, and otherwise well said, regarding the intention and the method of Object Lessons.

The book is divided into two parts. The first 20 pages contain detailed suggestions for a short series of lessons on household work, with words and music of songs to accompany them. The second part comprises a series of short pieces of information, on the whole well selected, on various household matters. These, however, give the matter only which would require to be arranged and adapted to lesson form.

The subjects of the detailed lessons are on daily household work, kitchen, bedroom, setting the breakfast table, washing dishes, rules for the day's work, and the like. They are therefore thoroughly practical, good, sensible observations, and directions abound as to what these matters require, and how they should be done. The knowledge suggested is valuable for every girl. But when we come to the suggested methods, so much cannot be said. The lessons are evidently intended for elder girls, the things taught being such as they only could properly appreciate and properly follow. Yet to each part is attached a song on the subject, the style of which is extremely childish, the rhythm halting, the rhymes faulty. It surely would be putting too great a tax upon the self-control of upper standard girls to expect them to sing with any sense of reality and propriety of demeanour such a 'refrain' as this:

> 'Oh, deftly and so cheerily
> She does the work with nicest care;
> She never stops, and never pouts,
> Because there's lots to do there.'

or this, part of a 'Rhyme, to be said in unison,' on bed-making:

> 'Turn it down at the top, That in you may pop.
> Now say your prayers, Lay aside all your cares,
> And rest your small head; For teacher has said,
> You're a dear little girl, And can make a nice bed.'

Not more satisfactory is the guidance as to particular method of giving a lesson; that is, at least for class teaching in ordinary schools. For instance, precise directions are given for conducting a lesson on 'Laying the Breakfast Table.' A box of table-setting materials should be placed in front of each girl towards her right hand. Towards her left, place the table board. Each action can be guided by a chord on the piano, &c. So for the lesson 'On Bedmaking'—'a bedstead and bedding, and two chairs will be required between each two girls.' It is evident that if the children of the poor are not taught their household duties till resources of this sort are provided in their schools, the next generation will not be much in advance of the present in this respect.

The book is illustrated by several rather old-fashioned prints, showing a few girls seated round a table, or occupied in various ways, as unlike the class arrangements of an average school as the methods suggested are unfitted for use in them. We have dwelt at some length

on these points because this book is a type of not a few which are put forth as guides to the teacher, but which are the product of writers, who, however well-intentioned, have no adequate conception of the present limits and conditions of Public Elementary School work.

There is a considerable amount of information on many useful topics in the latter part of the book, and some good hints may be gathered from its earlier part, but both the one and the other will require considerable modification to adapt them satisfactorily to the requirements of the common school. The book is well printed, on exceptionally good paper, and is strongly and neatly bound.

Arithmetic. By Charles Pendlebury, M.A., F.R.A.S. London: G. Bell and Sons.

This is a magnificent collection of nearly eight thousand examples, which have been so carefully verified that no doubt as to the correctness of the answers need be entertained.

The preface assures us that 'everything like an arbitrary rule has been carefully avoided; such guides and directions as are given for the solution of questions being deduced as the outcome of simple explanation and simple reasoning.'

To make this statement quite correct we ought to italicise the term 'solution,' for at page 15 we find the rule for *testing* the correctness of a product by the process called 'casting out the nines' given without one word of explanation, and though the *rules* for testing the divisibility of numbers by the smaller numbers (except 7) are stated on page 23, no student, with nothing but this manual to teach him, could give the reason for these tests.

In G. C. M. there is no hint as to the advisability of casting out a factor which is contained in one of the numbers and not in the other or others.

Decimals are not introduced until after the compound rules and even vulgar fractions; but we are glad to see that they are treated of as an extension of the ordinary mode of representing whole numbers, vulgar fractions being only used in their treatment for purposes of illustration.

No one can doubt that it is far easier to get young students to talk intelligibly about the simple operations of addition, &c., with pounds, shillings and pence, or pounds and ounces, than with abstract numbers, and we therefore quite approve of the author's introducing money and weights as early as possible; and we must say, in passing, that his method of explaining the ordinary notation with piles of coins or counters is decidedly good and clear.

Proportion is treated of very briefly—all questions involving its idea being worked out by the unitary method. Though doubtless the unitary method is sometimes very useful; yet to discard all other methods of working such questions is, we think, an unnecessary pandering to arbitrary codes and examiners' whims.

Stocks and Shares are treated of fully and in a decidedly interesting way.

Scales of notation are explained towards the end of the book, and these are followed by duodecimals, and a chapter on decimal coinage, weights and measures.

The book concludes with 50 pages of examples in addition to those inserted after every rule; and, as we said at the beginning, we cannot help thinking that the value of the book almost entirely consists in these examples, which are not only numerous but varied; and, for such, we recommend it to teachers and others.

The Planisphere. Philip and Son: London and Liverpool.

This simple piece of apparatus enables us to map out the stellar groups with the greatest ease. If used a few nights consecutively the apparent annual movements of the heavenly bodies can be determined. For this reason alone we have no hesitation in hailing with satisfaction the appearance of this effective and artistic appliance.

Sir Roger de Coverley: Essays from the 'Spectator.' With Notes and Illustrations by David Salmon. London: Longmans, Green and Co.

There is no need to praise the charming essays on Sir Roger de Coverley and his friends which first delighted the readers of the Augustan age of English literature, and have contributed to the pleasure of so many generations since. Eminent critics, from Johnson to Macaulay, have recognised them as models of unaffected gracefulness of style. The series of twenty-six essays, with No. 1 of the 'Spectator' as author's preface, were selected by Mr. W. H. Wills some five and twenty years ago, and are now reissued by the publishers as a book for students. The new introduction, contributed by Mr. Salmon, gives proof not merely of extensive reading and an intimate acquaintance with the literary history of Addison and Steele's time, but also of what are more important but less common, a lively appreciation of the spirit which informed the literary and political life of the reign of Anne, and considerable ability in presenting the results of careful study so as to attract and stimulate the student.

The passage in which Steele and Addison are compared seems to us particularly happy. 'After all it is foolish to speak as if the praise of one implied dispraise of the other; each had great and characteristic merits, and though Addison was on the whole decidedly superior as a writer, Steele in some respects excelled him. Addison's humour was equable, Steele's fitful; Addison burnt with a steady glow, Steele sometimes burst into intense flame, sometimes sank into a flicker. Steele's conception of woman was far higher than Addison's; Steele could worship her; Addison behaved to her as a polished gentleman, but one can sometimes detect half contempt lurking behind the smile which plays upon his features as he notes her little weaknesses. Finally, Steele could originate and Addison elaborate.'

We are rather surprised in such careful writing as Mr. Salmon's to find two or three well-known quotations printed without marks of quotation; for example, in the first paragraph, Pope's line 'the right divine of kings to govern wrong,' and on page 27, Burns' 'the best laid schemes o' mice and men gang aft agley,' in which also *men* seems quite needlessly altered to *statesmen*. We notice, too, at the top of page 13, 'for more than a year his circumstances were so *straightened* as to call for all his philosophy;' surely *straitened* is intended.

These, of course, are small blemishes, and only slightly detract from work so generally well done. The notes are extensive and thoroughly adapted to their purpose, as they throw much light on literary history, and, in the numerous extracts from other authors, supply information which to many students would not be easily accessible. The book is also suitable for reading in the upper standards of elementary schools, and for reading and study in middle-class schools. The paper and the binding are very good, but the typography is not quite what we are accustomed to find in works issued from the house with 'the Sign of the Ship.' As we are told the text is identical with that published a quarter of a century ago, we thought at first that the old stereotype plates might have been used, and were no longer capable of producing a clear and perfect impression, but we find the same imperfection in a slighter degree in the new matter of the introduction and notes. It may be that the copy before us is an early and faulty one.

Standard Test Maps for Memory Work. Geo. Philip and Son: London and Liverpool.

We have spoken with approval of the sheets of this Series previously issued. Those now before us will be most serviceable in the preparation of children for the Standard work in Geography. The matter has been selected with sound judgment and is printed with skill and pleasing effect.

Longmans' New Geographical Readers. The Fifth Reader for Standard V. Europe. London: Longmans, Green, and Co.

This volume forms a worthy continuation of the series. It is a genuine reading-book in which the lessons are not compiled on the simple but uninteresting plan of recasting into sentences the lists and tables of formal text books on geography. The reason and imagination of the pupils are freely wrought upon in the lessons, which consist of carefully written descriptions of the general features of the continent, and of the special features of the various countries and their inhabitants. In one lesson is embodied Miss Martineau's famous description of the Fjords of Norway, in another Longfellow's description of rural life in Sweden, in another Lady Brassey's description of Stamboul. Most of the lessons, however, are original, and in support of our good opinion of their style and character we could quote many passages; but we content ourselves with the following on the scenery of Switzerland:—

'Switzerland is, above all other countries in Europe, a land of mountains. As such it is famous in history; and, because of the wonderful scenery of its mountains and lakes, it is visited every year by crowds of tourists from the rest of Europe and from America. Though the highlands of Switzerland are not on so extensive a scale as those of Scandinavia, though its glaciers are not so vast, its waterfalls not so high, its ravines not so profound, yet its snow-clad mountains are much loftier than those of the great northern peninsula, and its rugged and sublime scenery is associated with a much more luxuriant vegetation in the deep valleys. So that the landscapes of Switzerland present to the view a combination of grandeur and beauty that cannot be equalled in any other part of Europe.

'Few scenes are more likely to dwell in the memory of the spectator than those in which he may see on one side a magnificent lake spread out in a smiling valley, while there rises on the other side a jagged range of snowy mountains. And the sight is even more wonderful when, on the evening of a moist summer day, the setting sun suffuses the mountain tops with a rich, rosy red, reflected with varying brilliancy from snow and ice, from naked crag and rocky pinnacle.'

A few passages of poetry in which Coleridge, Longfellow, Goldsmith, Bayard Taylor, Byron describe some of the famous scenes of the Continent serve to relieve, to illustrate, and to supplement the other lessons; aud a similar service is rendered by the graphic art of the engraver in the many beautiful woodcuts inserted in the volume. Some of these—as Rouen Cathedral, Cologne and its Bridge of Boats, and Bergen Bay, are particularly striking. About a dozen clearly drawn maps, printed with the text, are placed on pages opposite to summaries of the main geographical facts respecting the different countries. The regulation number of sixty lessons is followed by a few pages containing a general summary of the geography of Europe, and two engraved maps of Europe, physical and political, printed on vegetable vellum, and folded so as to be opened and used in connection with any page of the book.

As in the case of Longmans' new series of reading books, noticed above, the paper, printing and binding are all that can be wished. Perhaps it may be questioned whether the light stone-coloured covers are not too delicate, and likely to show finger-marks very readily.

Blind Olive. By Sarson C. J. Ingham: Wesleyan Methodist Sunday School Union.

The short Preface tells us this Story is 'the effort of the Story-wright's 'prentice hand.' We can only say, since the first effort is so good, the writer ought to persevere and prosper.

This is a second edition, we notice, and that other efforts have been put forth by the Author, which we should like to see.

We don't intend to tell the story, which is so simple and yet so touching that it might almost be couched in the form of a Ballad. The few figures that appear on the scene are well drawn, but the one that struck us most was that of the faithful attendant of the afflicted heroine who is one of those true women of whom the world take no notice, but who are no less the true salt of the earth.

If the story have a moral, it is, we presume, that a true lady is unaffected by social position or surroundings, and that such is an important truth which all true men should gladly acknowledge.

In fine we do not know when we have read so healthy a little story, nor one more suitable to give to girls of any station of life.

Whittaker's Parallel Series. Shakspere's Plays, English and German, edited by Charles Sachs, Professor, Ph.D. Henry VIII., King Lear. London: Whittaker and Co.

These two volumes are the third and fourth of a series of selected plays of Shakespeare, in which the English text is given on one page with a German translation on the opposite one. An introduction, also printed in English and German on opposite pages, precedes each play, and by its minute bibliographical character bears witness to the almost exhaustive research which so commonly marks the German scholar and student. The fact that the translation of the text is that of the great German critic, A. W. von Schlegel is sufficient warrant not only for its literary merit but for its being conceived in the true spirit of a Shakespearean scholar, whose acquaintance with the original was extensive, and whose appreciation of its meaning was genuine and discriminating. The arrangement of the text and translation will make the series very serviceable to English students of German, and also to German students of English. The volumes form handy pocket companions, and are published at a very moderate price.

Junior Graduated French Course. By Professor A. Barrère. London: Whittaker and Co.

The appearance of this book suggests, and the imprint proves, that though published in London it is printed on the Continent. It is intended to introduce young pupils to a more advanced course 'in the form of Examination Papers,' and this end its author seeks by a series of short simple readings in French to be translated into English, each passage being followed by grammatical questions in French, and a few sentences, founded on the passage, to be translated from English into French, and also conversational questions in French on the matter of the lessons. Each lesson is thus divided into three portions, and occupies one page of the book. The short readings are varied and interesting, including descriptions of natural scenes and objects, anecdotes and fables. No grammar is given, and therefore some other book must be used, or the pupil must depend largely on the tutor's personal instruction. No English is given, except in the sentences for translation and in the vocabulary. The method laid down and exemplified seems a very good one, and we understand it has stood the test of experience.

The Elements of Plane Geometry. Part II. Corresponding to Euclid, Books III., IV., V., VI. Swan Sonnenschein and Co.

This edition of Geometry is prepared by the committee appointed by the Association for the Improvement of Geometrical Teaching.

The title-page tells us that the elements of geometry treated of in this part correspond to certain Books of Euclid; but the student must not be misled by this, and think that by studying this manual he will have studied Euclid, for, we regret to say, he will not have done so.

Mathematical masters in large schools have on one or two occasions succeeded, by introducing newfangled geometries into the schools whose mathematical teaching is under their care, to keep books of this kind alive for a

short time, but just as they have been successful to do this only for a time, so we believe will the committee of this ambitious association be successful only for a short time.

We trust the day is far distant when any proofs but Euclid's will be accepted by the principal Boards of Examiners. That Euclid has omitted stating certain axioms that he uses, that he at times misses a second or third construction possible, and that there are propositions which can be proved in an easier way, and yet according to his lines of reasoning, no one can doubt, but that there is any necessity to make such sweeping changes as are introduced into the manual before us we utterly deny, and we trust that examining bodies will put their veto definitely against the acceptance of such changed methods and often inverted order as we find here.

We regret to be obliged to speak as strongly as we have done on the book as a whole, because in its details there is so much in it to admire, and which could so well be introduced into a Euclid proper, without in any way altering the text of the book itself or its arrangement. As an example: the first section of this Part is devoted to the elementary properties of the circle, many of which Euclid takes for granted, to wit 'that the distance of a point from the centre of a circle is less than, equal to, or greater than the radius, according as the point is within, on, or without the circumference,' which is here rigidly proved. We also have in this section a definition of point symmetry, which is cleverly used.

Euclid, no doubt, imagined the possibility of an angle at the centre of a circle greater than two right angles. We must not, therefore, find fault with the editors for treating an acute angle as sometimes standing on the greater arc of the circle, and being, therefore, greater than two right angles; but for all that we very much prefer Euclid's proof of the properties of the quadrilateral inscribed in a circle to the one found here.

There are many well known problems not proved by Euclid, which are here introduced, not as problems, but as propositions, and duly numbered.

We remember Whewell writing in the Preface to his Mechanical Euclid that so much did he value the uniformity of the numbering of Euclid's Propositions and Newton's Lemmas that he trusted the Mathematical world would no less accept the numbers of his Mechanical Euclid, so that to all time the number of the proposition which proved the parallelogram of forces, or a portion of it, might be as fixed as that of the celebrated 'pons,' or the 47th of the First Book.

That his wish was not carried out we know, and that there was a slight self-seeking in the suggestion we may fear, still nothing that that great man said can be gainsaid lightly; and the uniformity of the order of proof which would be insured by this would be something.

We are glad beyond measure to see that the editors have made an effort to restore the pure geometrical reasoning of the Fifth Book of Euclid. Whether they will succeed or not, it will always remain to their credit that they have tried to do so. In this particular Book, numbered here IV., not V., there are as suggested by other editors, no figures at all, which we think as well.

With regard to this portion of geometry we should be glad to see it determined by the examining bodies of the kingdom that no certificates in the later Books of Euclid would be granted to any candidate who did not satisfy the examiners in this part of the subject as treated by Euclid.

The manual is constantly interspersed with numerous examples, and for these alone it would be found valuable, though in some cases the student would require to have learned the new phraseology.

We can quite well understand an intelligent teacher making considerable use of the manual, without in any way interfering with the regular course of Euclid through which he was putting his class; but as a text-book for young students to prepare with, for an examination in geometry, unsupplemented by Euclid's method, we object to it entirely.

The Musician: a Guide for Pianoforte Students. By Ridley Prentice. Fifth Grade. W. Swan-Sonnenschein & Co.: Paternoster Square.

Taking for its text Schumann's remark that 'only when the form grows clear to you, will the spirit becomes so too,' this admirable series of books aims 'to help pianoforte students to acquire, through careful study and analysis of the pieces they play, some insight into musical form.'

Mr. Prentice has divided his work into Six Grades—each complete in itself—the whole forming a complete graduated course, with each selected piece analysed both as to form and spirit and illustrated by interesting references to the Composers, their habits, idiosyncrasies, and compositions.

Not only does the work deal with *Form* so-called, but every department of musical theory is touched upon, defined, and illustrated. Thus we have gradually introduced, Musical Terms, Scales, Intervals, Harmony, Modulation, Counterpoint, etc.; presented in an attractive light and calculated to awaken the interest and intelligence of the pupil.

The Grade before us opens with a clever account of the aims and purposes of Music, and a forcible reminder that the 'beautiful strains which afford so much delight are not the result of mere chance, and do not represent a fortuitous concourse of atoms.'

Beethoven and Mendelssohn, the one with his note-books jotting down ideas and writing and re-writing them till almost all trace of the original is lost, the other subjecting his compositions 'to searching and relentless criticism,' afford a striking view of the indefatigable labour which even *genius* requires in order to produce works of the highest merit.

For the benefit of somewhat advanced players who have not studied the preceding grades, a recapitulation of definitions, &c., precedes the discussion of the pieces specially selected for analysis in Grade V., which opens with Beethoven's Sonata in A flat, Op. 26.

Concerning this well-known Sonata an interesting paragraph is recorded of an artist named Wehrstädt:—'He summed up by saying that by following his advice, I might hope to play the first eight bars *fairly well* in a year's time; the crescendo at the ninth bar would require a new and serious study of the crescendo in general and of that one in particular; as for the answering sentence (bars 16 to 26), I must give up all hope of ever succeeding in playing it, . . . a study of twenty years not having sufficed in his own case for the attainment of invariable accuracy in its rendering.'

As brevity is the soul of wit, so are conciseness and clearness the very essence of a definition; and what could be more felicitous than the following?—'CLASSICAL MUSIC may be defined as music in which the thoughts, beautiful in themselves, are also beautifully treated.'

And so on throughout the whole book, definition, quotation and illustration combine to render the work one of the best and most instructive we have ever seen.

The fifth Grade closes with an analysis of the Moonlight Sonata. We can only hope that Mr. Prentice's efforts will be as much appreciated and as successful as they deserve to be. In the hands of a capable teacher the 'Musician,' will lay the foundation of a solid and intelligent Musical education.

Illustrations of Natural Phenomena. London: The Educational Supply Association.

These four wall pictures illustrate respectively (1) an Avalanche, (2) an Iceberg, Glacier, and the Aurora Borealis, (3) a Volcano and a Geyser, and (4) an Earthquake; and although exception might be taken to some minor details, there is no doubt the series will prove on occasions of considerable service in class work. In the case of the first named picture we might for example complain of a Geyser being 'located,' to use an Americanism, in the neighbourhood of a volcano which, from the people dressed in Neapolitan style dotted about here and there, we must assume to be Vesuvius, when the

artist might easily have avoided all such error of locality by simply taking Hecla as his example of a volcano and introducing a geyser or two in the foreground. Young people find it difficult to distinguish between an ideal and a real view, and will be apt to imagine that the sunny district round Naples is the *locale* for geysers instead of the rocky regions of Iceland. The picture illustrating the earthquake is freer from faults, and the ruin wrought among the buildings, the huge fissures in the ground, and the immense sea wave devastating the shore, are all carefully shown, and will doubtless remind many teachers of the terrible catastrophe which happened in Ischia in July, 1883, when 2,300 lives were lost and the town of Casamicciola was entirely destroyed. The other two plates illustrating an Avalanche and a Glacier, are in the main accurate, though the former is perhaps somewhat exaggerated. By selecting a coast glacier such as is found on the Greenland coast, the artist has been able to show how icebergs are sometimes formed by the breaking off of the projecting end of the glacier by the action of the sea.

Geography of the British Colonies. By Rev. John P. Faunthorpe, M.A., F.R.G.S., Principal of Whitelands College. Philip & Son.

This well-known text book has reached the fifth edition. In its present form it has been revised and enlarged, and forms a comprehensive and reliable source of information respecting our Colonial Empire. Primarily this work is intended for use of students in training college who are preparing for the second year's certificate examination, it may with advantage be used as a hand-book by all who are interested in the geographical facts connected with 'Greater Britain.' The appearance of a new edition during the year of the Colonial Exhibition is especially opportune. Educationally this book will long hold its own against the multitude of text books on Colonial Geography which for the most part present in tabular form the 'dry bones' of geographical facts. We welcome the present edition and forecast for it a speedy sale.

Handwriting and how to teach it. By H. Gordon: John Marshall and Co.: 42 Paternoster Row, E.C.

This little treatise abounds in good advice. How to write is clearly stated and common errors are indicated and abundantly illustrated. Writing is an art and requires above all things excellent models for imitation. This is the chief omission in Mr. Gordon's book. Models of handwriting are few, and those given are not well executed. Take *e.g.* the small hand copies on page 93. The letters a, c, e and l are ill-shaped; d and p are wrong in length of stroke; the loop of j and g are very faulty; the lower curve in most letters is too pointed, whilst both stroke and slope are irregular throughout the entire page.

Owing to the exceptional pressure on our space this month, we are reluctantly compelled to hold over until our next issue, 'Notes of a Lesson,' by J. H. Cowham, F.G.S., 'Publications Received,' and a large number of Reviews. With our next number we begin a new volume, which will contain several new and important features.

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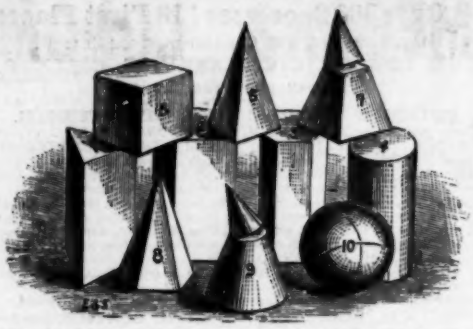

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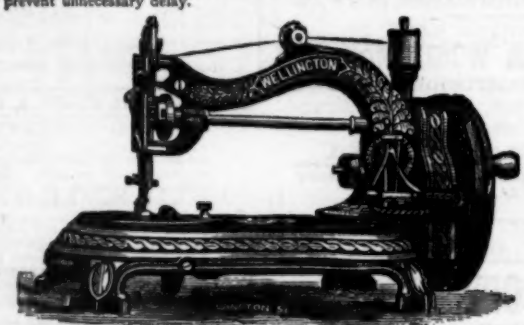

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